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The objects of the American Geographical Society are to collect and disseminate geographical information by discussion, lectures, and publications; to establish in the chief city of the United States a place where may be obtained accurate information on every part of the globe; and to encourage such exploring expeditions as seem likely to result in valuable discoveries in geography and the related sciences.

The American Geographical Society is the oldest geographical society in the United States. When it was founded, in 1852, there were but twelve similar societies in the world. Now it exchanges publications with more than four hundred scientific associations. The Society issues a ~~monthly~~ quarterly magazine of unusual appeal, *The Geographical Review*, which contains authoritative articles of general interest. It has also a large and growing library—one of the most important geographical libraries of the world; thousands of maps and charts; and a remarkable collection of atlases of the sixteenth, seventeenth, and eighteenth centuries.

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OUR CONTRIBUTORS

M. Gautier is professor of geography in the University of Algiers. He is an authority on the geology and geography of northern Africa. His numerous writings on this region include the important volume "Le Sahara algérien" (1908). He has also written "Madagascar, Essai de la géographie physique" (1902).

Dr. Jones is assistant professor of geography in the University of Chicago. He acted as economic geographer on the Hydrological Commission (Argentine Ministry of Public Works) that under the direction of Professor Bailey Willis carried out surveys in northern Patagonia, 1911–1913. In 1916 under the auspices of the University of Chicago Dr. Jones was engaged in geographical investigation in China and Japan. These eastern studies he has now resumed, his present expedition taking him to India.

M. Blanchard is professor of geography in the University of Grenoble, France and head of the Institute of Alpine Geography which is engaged in detailed regional study of the French Alps. In this field M. Blanchard has made many notable contributions including a model city geography, "Grenoble" (1911). He is also the author of the regional geography "La Flandre" (1906). While visiting professor at Harvard he wrote the article "Flanders" for the *Geographical Review* (Vol. 4, 1917). He is joint author with Miss Millicent Todd of "Geography of France" a volume primarily written for the American Expeditionary Forces in France.

Dr. Kindle is paleontologist in charge of invertebrate paleontology, Geological Survey of Canada. Previously to this appointment he was associated with the Geological Survey of the United States as geologist and paleontologist. Dr. Kindle has recently carried out investigations in the Mackenzie River Basin, an outcome of which was the paper "The Arrival and Departure of Winter Conditions in the Mackenzie River Basin" contributed to the *Geographical Review*, December, 1920.

Dr. Griffith Taylor, formerly Physiographer in the Commonwealth of Australia Bureau of Meteorology, Melbourne, is now associate professor of geography in the University of Sydney, N. S. W. He has distinguished himself by his fruitful application of climatology to the problems of settlement and human adaptation to environment in general. His main publications in this field are: "The Control of Settlement by Humidity and Temperature, With Special Reference to Australia and the Empire: An Introduction to Comparative Climatology" (*Commonwealth Bur. of Meteorol. Bull. 14*, 1916; see *Geogr. Rev.*, Vol. 4, 1917, pp. 401–403. and Vol. 5, 1918, p. 86); "The Australian Environment, Especially as Controlled by Rainfall" (*Commonwealth Advisory Council of Science and Industry Memoir No. 1*, 1918); "The Climatic Control of Australian Production" (*Commonwealth Bur. of Meteorol. Bull. No. 11*, 1915, see *Geogr. Rev.*, Vol. 1, 1916, p. 396); "Geographical Factors Controlling the Settlement of Tropical Australia" (*Queensland Geogr. Journ.*, No. 18–19, 1918) reprinted in abridged form in the *Review*, Vol. 8, 1919. The research commenced in "Climatic Cycles and Evolution" (*Geogr. Rev.*, Vol. 8, 1919) is continued in the present paper.

Mr. C. E. P. Brooks is a member of the staff of the British Meteorological Office. He is the author of the recently published Geophysical Memoir (M.O. 220 e) "The Climate and Weather of the Falkland Islands and South Georgia." His numerous contributions to the *Quarterly Journal of the Royal Meteorological Society* include "Continentality and Temperature" (Vol. 43, 1917 and Vol. 44, 1918) and "The Secular Variation of Rainfall" (Vol. 45, 1919), papers dealing with questions of climatic change.

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ANNOUNCEMENT

The Society announces a change in the form and character of its publications incident upon the adoption of a program of intensive research. With this issue the *Geographical Review* ceases to be a monthly periodical and becomes a quarterly to be issued in January, April, July, and October.

Parallel with the *Review* there will be issued a Research Series. Of fourteen numbers of the series already projected, two are in press (to be distributed in a few weeks), and several others will be printed in the early months of the current year. The scope is comprehensive, and the contributions for the most part will be original in character. The first of the series is Bering's Voyages by Professor F. A. Golder. It contains the logbook of the famous voyage of exploration of 1741, a map of Bering's course as compiled by Captain Commandant E. P. Bertholf of the U. S. Coast Guard [retired], reproductions of old maps to illustrate the state of geographical knowledge of the North Pacific before Bering's time, and the historical and geographical setting of the problem by Professor Golder. The second volume in the series deals in the same manner with Steller's Journal. The third volume is a geographical study of the relation of topography to strategy as illustrated by actual examples from the battle fields of the late war ranging from the North Sea to the Balkans. Professor D. W. Johnson, the author, a Major in the United States Army, visited the chief theaters of action during 1918, and in this book, illustrated with many maps and photographs, he has made to the subject of military geography a contribution of the first importance. Other volumes of the Research Series will be announced as published.

The Society, with the co-operation of the National Research Council, is preparing to publish a set of three maps of Africa dealing respectively with soils, vegetation, and land classification. These maps have been compiled on the scale of 1 : 5,000,000 by Messrs. C.F. Marbut of the U. S. Bureau of Soils and H. L. Shantz of the U. S. Bureau of Plant Industry after a systematic examination of a large collection of published material supplemented by study in Africa by Mr. Shantz lasting over a year. It is hoped that this, the

first document of the kind, will have a world-wide interest and utility, although it is of course largely preliminary in character.

The time is opportune for a published announcement of the Society's plans for research in the geography of Hispanic America. The proposed work, of which a brief outline was presented at the April, 1920, meeting of the Association of American Geographers and the Society and shortly thereafter to the National Research Council, Division of Geology and Geography at Washington, includes the preparation of a number of monographs and handbooks on selected regions and special geographical topics relating to the Hispanic American realm and Brazil. The work will involve the compilation and publication of maps—topographic and distributional—on various scales, but always including sheets on the scale of 1:1,000,000 which will conform to the scheme of the International Map.

The program further includes the production of complete distributional maps of Hispanic America similar to the maps of Africa referred to above.

The program has been initiated with Mr. Alan G. Ogilvie, formerly of the University of Manchester, England, in immediate charge. Professor F. J. Teggart, of the University of California, will have charge of the section of historical geography. Mr. G. M. McBride, former Librarian of the Society, has undertaken a part of the program, being engaged at present upon the question of land tenure in its geographical aspects. Various assistants have also been appointed, including scholars from several South American countries.

To meet the technical map requirements there will be established at the Society a School of Surveying. The School, which will be opened to students October 1, 1921, will be under the direction of Dr. Alexander Hamilton Rice, a recent Gold Medalist of the Society and now one of its Vice-Presidents. It is proposed that graduates of the School shall be engaged in part in field surveys of high quality from which there will result improved topographic data for the regions selected for geographic study.

To insure the success of the undertaking the co-operation of the whole group of Hispanic American countries is contemplated. The Society is happy to say that assurances of such co-operation have been given in a cordial spirit that augurs well not only for immediate scientific results but also for the fostering of mutual understanding and sympathetic relationship towards which the field of geography offers a peculiarly fortunate approach.

NOMAD AND SEDENTARY FOLKS OF NORTHERN AFRICA

By E. F. Gautier
University of Algiers

For the last 20 years I have been familiarizing myself with the Algerian Sahara. A recent journey in Egypt has drawn my attention to the differences between the eastern and western portions of the great desert. From the human point of view the essential difference lies in the relations between the nomad and sedentary folk.

The Algerian Sahara

In its entirety the French Sahara occupies not less than half the area of the United States.[1] The map, Figure 1, accompanying the present article represents the best known part, the northeastern corner conventionally described as the Algerian Sahara. It is of the inhabitants of this region that I here propose to speak.

The physical stamp of this part of the Sahara, as I have elsewhere pointed out,[2] is its skeleton framework of great Quaternary wadis. Strictly related to the existence of these wadis are the pasture grounds of the nomads. Sometimes the floor of the wadis is carpeted with the xerophilous plants upon which the camel browses. But there is also a vegetation of the dunes. The dunes, or *ergs*, are the alluvium of vanished rivers accumulated in the basins by eolian transportation.

Tuaregs and Shambas

These two great categories of pasturage, that of the wadis and that of the dunes, correspond to a distinction of nomadic tribes: Tuareg in the one case, Shamba in the other. Of course this does not mean that the Tuaregs never pasture their camels on the dunes nor the Shambas in the wadis; but broadly speaking the Shambas are nomads of the *erg*, the Tuaregs of the rocky plateaus. It is a fact that the camels of the Shambas, accustomed to treading sand, wound their feet on the rocks of the wadis far more than does the Tuareg camel.

The most important point of distinction in the relations of these nomads is a matter of situation. The *erg* country occupied by the Shambas is comparatively near the sea, and the people are in close touch with the

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[1] Readers of the former *Bulletin of the American Geographical Society* will recall the map of the French Sahara accompanying the article by W. A. Cannon, "Recent Exploration in the Western Sahara," *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 81–99.

[2] E. F. Gautier: Déserts comparés, *Ann. de Géogr.*, Vol. 28, 1919, pp. 401–413.

Mediterranean world. Furthermore, they are Arabs having community of language and sentiment with all the Near East. The Tuaregs in their mountains in the heart of the continent are 1,000 kilometers from the Mediterranean, which they have never seen, though for centuries they have con-

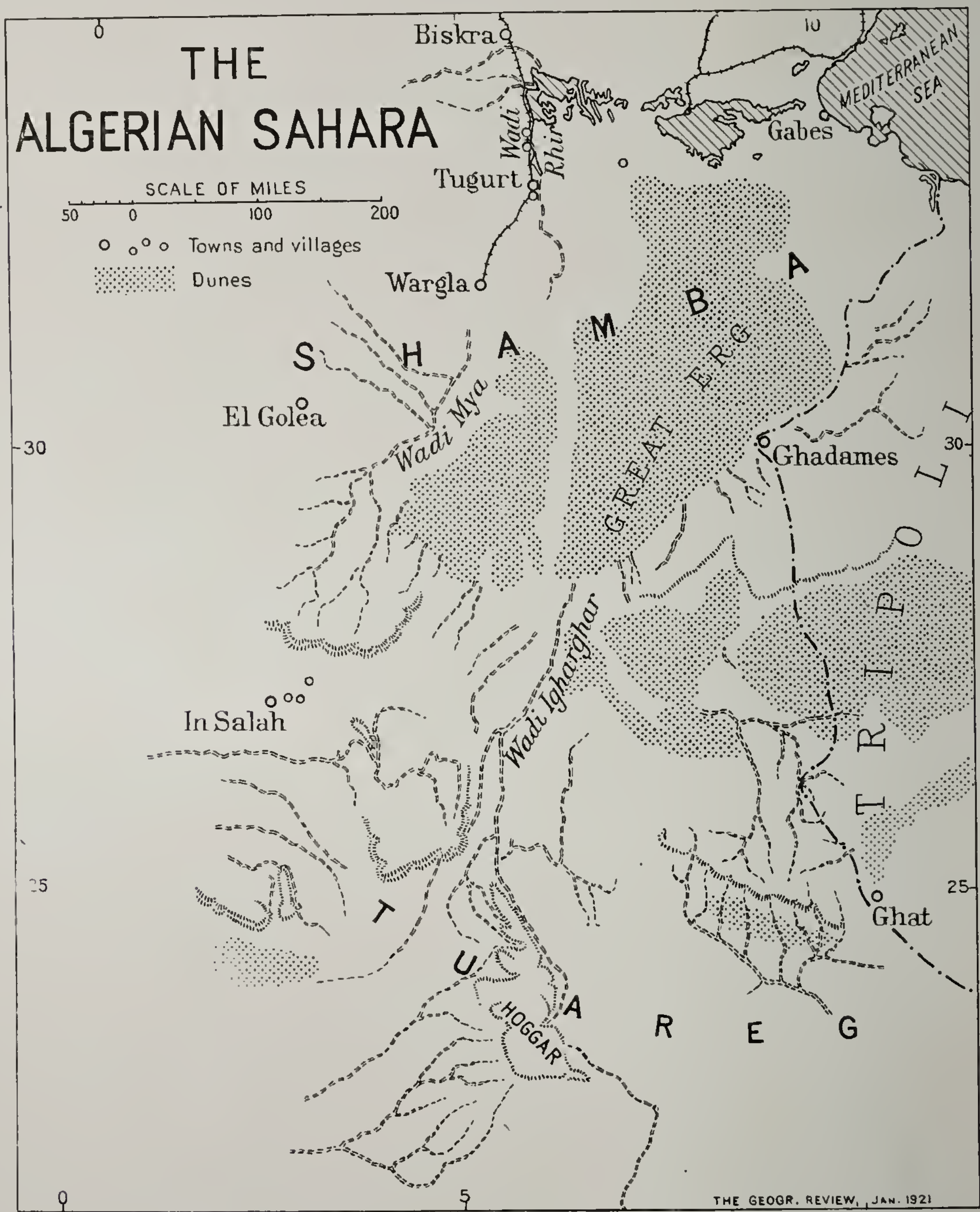


FIG. 1—Map of the eastern portion of the Algerian Sahara showing the oasis and the territories occupied by the Shambas and Tuaregs. Tugurt is the present terminus of the railway, the continuation to Wargla being projected. Scale 1 : 12,000,000.

trolled communications between it and the Sudan. The Sahara is theirs. They share its mystery. It has surrounded them with an aureole of romance bestowing on them a world-wide fame out of all proportion to their numerical importance. The name Tuareg is very generally known. It is to be found in every school geography associated with the name Sahara and used as the type of one great human group—the nomad. The Tuaregs are pure Berbers. They hate the Shambas; between them is perpetual and deadly

Fig. 2

Fig. 3

Fig. 2—Pasturage of the wadi in the Algerian Sahara. The rocky ravines are characteristic of the region.
Fig. 3—Pasturage of the *erg* in the Algerian Sahara showing the scanty vegetation of the dunes.

enmity. Yet as human groups they are closely comparable. They live the same kind of life adapted to the same desert. No attempt will here be made to distinguish them.

The Oases

In the same region are the sedentary cultivators of the oases. A group of oases lies in the region of the great shotts between Biskra and Wargla. Its economic heart is the Wadi Rhir, a chaplet of palm gardens of which the chief is Tugurt, terminus of the railroad. Another group is that of Tidikelt of which only the eastern extremity with the capital In Salah is figured in the accompanying map. The great oases of Ghadames and Ghat (Rhat) belong politically to Tripoli; but they are not alien to our discussion, Ghat especially.

All these oases are of the same type. Under the shade of the date palms are the irrigated gardens. Whence comes the water? From the name Wadi Rhir and its geographical situation along the lower Igharghar one might believe that it was supplied with water by the wadi. But no flood of the Igharghar or the Wadi Mya ever approaches the Wadi Rhir by some hundred kilometers. The water is artesian, obtained by wells. At Tidikelt the arrangement for obtaining water is more complicated; there is in use a system of subterranean canals known to the Arabs as *foggera*. But without exception water supplying the oases comes from a depth and is secured by processes of surprising technical complexity.

In the Wadi Rhir native tradition attributes invention of the artesian wells to Dhu'l Karnain (literally signifying the two-horned). This is the name by which Alexander the Great is designated in the Koran, but it is Alexander in his rôle as the son of Jupiter Ammon (Ammon Ra) in which official capacity he was worshipped in Egypt by the side of the sun god. All tourists to Egypt have seen the chapel of Alexander in the temple of Luxor. The photograph, Figure 4B, is the representation of Ammon Ra from the temple of Karnak at Thebes. Figure 4A is Dhu'l Karnain from a rock carving near Figuig (on the Moroccan border of Algeria) one of the largest oases of the French Sahara. The two localities lie 3,000 kilometers apart at opposite ends of the Sahara. The resemblances of the carvings are striking. It is the same ram's head that is represented with the same detail—the Two-Horned god of the oasis and of irrigation.

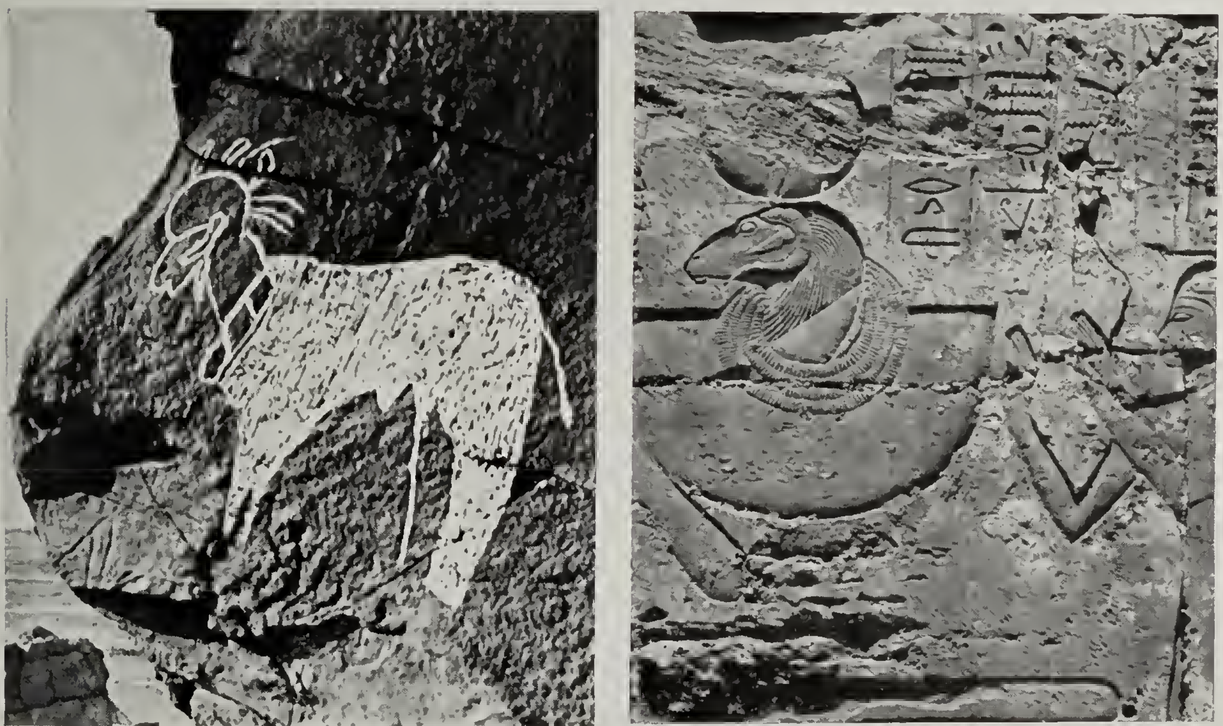
The technique of irrigation in the Algerian oases comes from Egypt, and it is interesting to note that traditions and native monuments preserve recognizable traces of their Egyptian origin. The technique of this old civilization is at strange variance with the barbarisms of those practicing it at the present day.

The oases dwellers are *Haratin*. The word comes from an Arab root signifying "to cultivate;" but it has lost its etymological sense and acquired an ethnic meaning, mulatto, and implies furthermore a mulatto type approaching the negro. The Haratin are a dark-skinned people. The

Tuaregs and Shambas are light-colored. Malaria, which is unknown on the pasturages, is on the contrary severe in the oases. Hereby may be explained the negroid aspect of the oasis dwellers, since for generation after generation there has been in operation a tendency to eliminate the more susceptible white element of the Haratin.

Relation Between Nomads and Oasis Dwellers

The sharp contrast that separates nomads and sedentary peoples does not mean, however, that these two human groups live independently of



A B

Fig. 4—A shows a rock carving near the oasis of Figuig which represents Dhu'l Karnain, the two-horned god of irrigation. B is a representation of Ammon Ra, the god of the oasis, carved on the wall of the Temple of Karnak at Thebes. The similarity of the figures suggests the identity of the two gods worshipped at the extremities of the Sahara.

each other. They are two parts of the same social mechanism, and its progress is dependent upon their collaboration. The life of the nomad is spent outside the oases, far from houses; with his family he dwells under the tent, almost, one might say, under the sky, in the pasture grounds and the paths leading to them. It is the life to his taste, his passionate preference. But from time to time he likes to descend on the oasis as the sailor likes to touch land. It is a psychological as well as an economic necessity. The nomad comes to the oasis to see men, to learn the news, to frequent the bazaars and the places of amusement.

It should be observed that the oases, even the smallest of some few hundred inhabitants, are towns, not villages. They possess the organs of urban life, as one readily appreciates at first sight. The architecture shows this, the storied houses with fine stairways, broad verandas opening on the

best exposure, and arcades. The building material is generally inferior. Stone structures are rare, almost everything is built of sun-dried clay. But in complexity of technique the methods of construction are a counterpart to the methods of irrigation, an inheritance of an old eastern civilization. Herodotus describing Babylon depicts the same contrast between the magnificence of the architecture and the inferiority of the material employed. Every oasis is a Babylon in miniature.

In this urban setting the life itself is distinctly urban. Each oasis has its market place, a sort of public promenade with booths. The places of amusement are indicative of the night life which is analogous to that of the low quarters of one of our ports.

There is also an economic side to the relations of the nomad with the oases. As regards food resources it is axiomatic that the nomad makes do what he has. There is the milk and flesh of his flocks, and he utilizes to an astonishing degree the wild plants of the desert. To cite but one instance, he gathers lolo, grains of a wild gramineous plant (Arabic drinn, *Aristida pungens*), for use as a flour, a side light on the domestication of wheat in the dawn of history. But such resources are yet insufficient. The nomad is tributary to the oasis for the greatest part of his vegetable diet, dates and cereals (wheat or millet).

On the other hand, he supplies the oases with indispensable products, in part of his own manufacture, rugs and fabrics woven by his women from the wool or hair of the flocks and herds or beautifully tanned leathers. He is also the intermediary bringing to the oases foreign goods, European cottons, for instance.

Subordination of the Sedentary Peoples of the Algerian Sahara

Such are the most fundamental relations between nomad and sedentary folk, not only in the Algerian Sahara but in all deserts and steppes. We shall now consider the peculiarities differentiating our region.

Here are two sets of people opposed to each other in every detail of their manner of life and even in their racial characteristics. Yet the social fabric is woven of their intimate relations. Our European societies are troubled by class strife, but the difference between our classes is far from being as profound as that which separates nomad and oasis dweller. How is equilibrium maintained? How are differences settled? Who polices and who governs? The answer is not far to seek.

Saharan society is of an anarchic and violent character. Familiar sobriquets for the region are *bled-el-khouf*, "country of fear," and *bled-es-sif*, "country of the sword." The oases are fortresses, walled and bristling with towers. Must one conclude that permanent warfare exists between the two peoples? Such is not the case in general. Each group fights amongst itself. The fortifications of the oases are primarily a protection against neighboring oases. A nomad tribe has for its hereditary enemy another

nomad tribe; there is a river of blood between Shambas and Tuaregs. Nomads and sedentary folk are too much complementary parts of one whole to engage in combat with each other. The sedentary folk would not think of offering resistance to the nomads. This fact will be appreciated if one reflects on the life of the latter. The desert climate, dry and severe, is very healthful. The nomad has the bodily characteristics of the white race. Save for certain rheumatic afflictions his strong frame preserves up to an advanced age an astonishing vigor. He passes his life from infancy to death wandering over the vast stretches of a region without security, where the distances between water may be as much as five or six days' forced march. He must travel fully equipped against attack, eating and drinking as little as possible. With empty stomach he must keep his head clear and his memory sure for topographic detail—under pain of death. To the dangers of nature are added those of his fellow man. Suspicion is bred in these monotonous solitudes. The nomad who encounters trace of human presence on the desert roads examines it with the inquietude of a Robinson Crusoe. The hard and dangerous life tempers body and soul, breeding a virile mind in the body of an athlete. This is the individual. In the tribes an instinctive disciplinary bond unites him to his fellows. Whether he guards the pasturage, escorts a caravan, or is actually taking part in a *razzia*, the nomad is a soldier every moment of his life. And the nomad tribe is a regiment.

FIG. 5—A covered passageway in the oasis of Figuig (western Algeria). Their buildings and institutions show the distinctly urban character of the oases.

What chance have the poor Haratin against this disciplined horde? They are conscious of their racial inferiority, and they suffer a similar physical disability. Spending their entire life in the narrow horizon of the palm gardens they are stunted in body and mind. The Haratin have solved the problem by submission—they obey.

Each oasis has its nomad masters who at the same time are its pro-

tectors, its guard and its army—in consideration of regular tributes, irregularly collected by some abuse of power. It is under these conditions that the Tidikelt oases and Ghat pertain to the Tuaregs; Wargla and the Wadi Rhir to the Shambas.

The nomads are a superior caste comparable in a sense to the feudal lords. According to a Tuareg saying, "Shame enters the family with the plow."

It is worth while noting that in their social life the Tuaregs preserve traces of the matriarchate and in their utensils reminiscences of the later Stone Age. They are in fact splendid intelligent animals. In this respect they make a notable contrast with their serfs, the sedentary Haratin, who still retain vestiges of an old civilization, the oldest civilization of the world.

Tuaregs, Shambas, Haratin as Type Peoples

Tuaregs, Shambas, Haratin—they are all without importance from the numerical standpoint. Their exact numbers we do not know, but assuredly the Tuaregs could not put a thousand warriors in the field. Their interest for us is as human types of two great classes of peoples in French North Africa. They are extreme types, it is true, a little overdrawn, as it were, but so much the more helpful for the visualizing of certain basal concepts in human geography.

The Tuaregs belong to a group of tribes whose ancestors, under the name of Almoravides, conquered Morocco and Spain and filled with their glorious exploits the history of two centuries. The Shambas claim for their forefathers certain tribes of Hillalian Arabs whose traditional fame is still sung by wandering minstrels in the coffee-houses of Cairo. Setting out on their triumphant career in the eleventh century these tribes progressively invaded all Barbary, overthrowing empires and putting to the sword the Sultans of Tlemcen and Fez.

Not all the nomad tribes of French Africa can boast so brilliant a past or so romantic a present as Tuareg and Shamba, but all are of the warrior clan; all enjoy a feeling of social superiority and share a disdain for sedentary life. In current talk the nomad is referred to by a respectful paraphrase, "the people of powder" or "the people of the sword" or again "the people of the tent." The tent is as respectable as the house. To the Algerian nomad the towns are *el khnez*, "nauseating." The son of a noble family is designated *kheima kebira*, "son of the great tent." A nomad tribe ruined by losing its camels and consequently its mobility enters on sedentary life with rancor in its heart. It is the supreme humiliation, an irretrievable loss of caste. There is an expression of the great historian Ibn Khaldun on the degenerate descendants of ancient nomad tribes, "They have become so abased," says he, "that they pay the impost." The true nomad levies tribute and pockets it.

Not all the sedentary folk of French Africa are as abject as the Haratin of the Sahara. One may instance the M'zabites and the Kabyles. These peoples have held their own against the nomads and have preserved their independence but at heavy cost, hard pressed and beleaguered behind their fortress walls or in their high mountain valleys. Under the most favorable circumstances the sedentary peoples form a commercial or rural democracy, a populace of barefooted *fantassin* in contrast with the nomad cavaliers, the gentlemen of the sword, the least of whom has the aplomb and nonchalance of the aristocrat.

Such is the situation in Algeria and in all French North Africa. At first contact with the Egyptian social organization one realizes with surprise that on the banks of the Nile the situation is reversed.

The Egyptian Sahara

The Nile, whose valley constitutes Egypt proper, cuts the Egyptian Sahara into two parts, the Arabian and the Libyan deserts. It is the latter only that supports a human element. This is in the Egyptian oases, Kharga, Dakhla, Farafra, Baharia, Siwa.[3] Here dwell the peoples we shall compare with our Algerians.

The oases are entirely comparable the one with the other, Kharga or Dakhla with Wargla or Ghat. As regards their appearance, the importance of the palm groves, the numbers of inhabitants, the methods of securing water supply, they are alike. On the identity of the details of the last we have already spoken in discussing Dhu'l Karnain. Herodotus has described at length this string of like oases stretching from "Thebes in Egypt" to the "Pillars of Hercules" and "the Atlas," passing by the "Oasis of Ammon."[4]

The very name oasis is applied by Herodotus to the palm grove that we know today as Kharga. Everyone knows that this word "oasis," which has passed into most European languages, is a term of Egyptian origin. It should also be remarked that in the oasis of Siwa (the modern name for the oasis of Ammon) the language in use is a Berber dialect. As regards the oases, then, the similarity of the two Saharas, Algerian and Egyptian, has an ancient and firm foundation. But from every other point of view there is no accord between them.

As I have shown elsewhere[5] the two deserts are physically dissimilar. There is nothing in the Libyan Desert comparable with the system of Quaternary wadis in the French Sahara. Erosion has there developed a topography illustrated in the photograph (Fig. 7). The surface presented is that of a level plateau of low altitude from which rise occasional isolated buttes, the *Zeugen Berge* which Passarge has described from the Kalahari, a landscape that can only be explained as the result of prolonged eolian

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[3] Only the Egyptian portion of the Libyan desert is discussed here; hence there is no mention of the interesting Kufra oases and the Senussi.—EDIT. NOTE.

[4] Herodotus, Bk. 4, Ch. 181.

[5] Article cited in footnote 2.

erosion acting through geological ages. The economic and human consequence is the absence of pasturages.

Another fact of first importance is the relative narrowness of the Egyptian Sahara. It is limited on the one side by the Red Sea, on the other by the enormous mass, completely arid and impenetrable, of the Libyan *erg*, an obstacle more repellent than the sea. Hence not only pasturage but

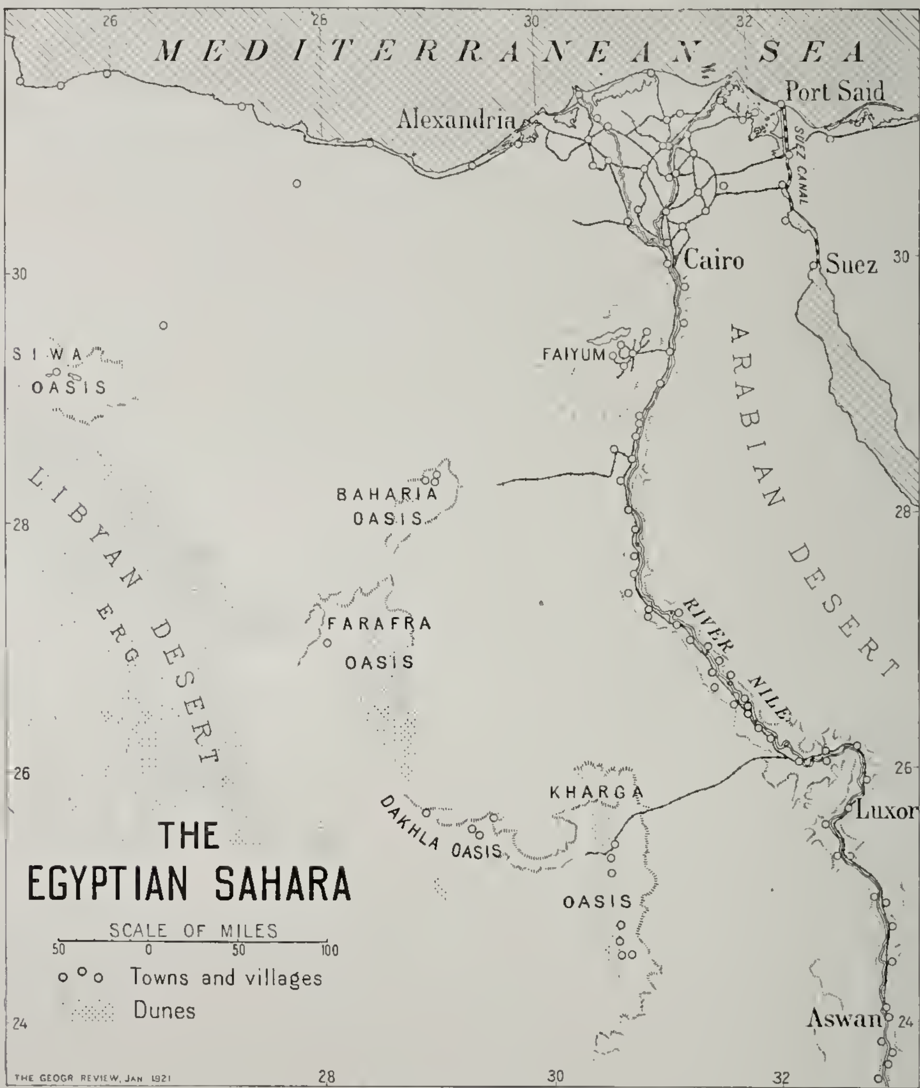

FIG. 6—Map of the Egyptian Sahara showing the oases of the Libyan Desert east of the great Libyan *erg*. Scale 1 : 9,000,000.

space is lacking the nomad. It must be said that Egypt itself is nothing more than a huge oasis, with that of Chaldea the finest on our earth. According to the last census (1911) Egypt had nearly 15,000,000 inhabitants. The presence in the heart of the Egyptian Sahara of such an agglomeration of sedentary peoples settles the question with the nomads.

THE BEDOUIN

The Egyptian Sahara has its Bedouins. Bedouin, the Arabic form of the word Bedawi, has passed into the European languages with the significance of nomad. The implication of the Bedawi is unflattering, and Bedouin

as we use it retains some of this derogatory sense—tatterdemalion. In Algeria it would never occur to any one to call the nomad "Bedawi." To do so would be ridiculous as well as dangerous. In Egypt the term does not offend anyone; not even the individual to whom it is applied.

The Bedouins are pastoral folk; they are the owners of camels and asses. But they pasture their flocks along the Nile under the control of the Administration. They are leaders of caravans, convoyers, commissaries. In

FIG. 7—A view of the Libyan Desert between Kharga and Dakhla. Prolonged eolian erosion has developed a level plateau region, from which rise isolated buttes.

the last resort they tend to mendicancy; joining what, in French, is known as the *armée roulante*, in English as the army of loafers. Anyone who has visited the pyramids under the escort of an Egyptian mule driver has seen the Bedouin in the discharge of one of his functions. Obviously such people are not of the warrior caste of Tuareg and Shamba with their long tradition of glory and dominion.

In the oasis of Kharga the tourist admires the temple of Hibis;[6] it is a little jewel comparable in its finish with any building of the Nile basin. At Siwa still exist the ruins of the great temple of Ammon where all the ancient world came to worship. The Algerian oases have nothing comparable. The Egyptian oases bear the mark of the eternal mastery of the Pharaoh. In contrast to Algeria Egypt is a country where the sedentary has always dominated the nomad by overwhelming force.

[6] See the photograph, Fig. 6, accompanying the article by W. H. Hobbs "A Pilgrimage in Northeastern Africa, with Studies of Desert Conditions," *Geogr. Rev.*, Vol. 3, 1917, pp. 337-355.

Meharists and the Camel Corps

The difference between the two Saharas is interestingly reflected in a point of detail—the form of the saddles used on the dromedaries. In Egypt the dromedary is saddled with a *gabit,* a type of saddle used, under a variety of local names, in Nubia, around the Red Sea, and in Syria. With some unimportant modifications which we need not consider here it has been adopted by the Camel Corps of the British army. This saddle encases the hump extending back and fore; it is roomy and commodious but a

A B

Fig. 8—A, soldier of the Camel Corps of the British army. The saddle used encases the hump of the camel while a leather foot rest is placed on the animal's neck. B, a Tuareg. The saddle is very light and is placed in front of the hump. The bare feet of the rider rest on the camel's neck.

trifle heavy. The idea of attaching the saddle to the hump is so natural that one finds it everywhere in Algeria as in Egypt. But for their fleet camels the Tuaregs and Shambas employ a saddle constructed on a different principle. They call it the *rahla,* a term signifying traveler, nomad. Without the slightest change it is used as the regulation saddle in the *Compagnies françaises de meharistes.* The *rahla* is placed on the withers of the animal in front of the hump, which remains entirely free. It is equivalent to the front half of the Egyptian saddle. It is lower and cannot be mounted during pursuit. The neck of the animal needs protection from the chafing of the saddle, and the rider must lighten himself of the heavy part of his equipment. It is obviously adapted to the life of the Tuareg as we have described it, to the crossing of great waterless spaces.

Conclusion

We have attempted to analyze the conditions of human life and the relationship between the nomad and sedentary folk in two corners of

the Sahara. It is a little subject, clearly defined. Its conclusions may be generalized to extend over all Algeria and all Egypt from the present into the remote past.

Egypt is the cradle of our Christian civilization. The Egyptian still retains the characteristics of a people of ancient civilization, the subtle intellect, the hypercritical spirit. One recalls the descriptions of Alexandrian times left by the ancient writers and reflects on the bond between the growth of a great empire of sedentary peoples and their civilization with its foundation of order, wealth, and peaceful leisure.

Algeria with her neighbors Tunisia and Morocco is the home of the Berbers (Latin *Barbari*). The history of the Berbers is that of endless, indefinite warfare. This is the civilization that produced Hannibal, Masinissa, Jugurtha, the Fatimite generals who conquered Egypt, the Moors who pushed their way through Spain into southern France. There is a bond between this exclusively militaristic past and the present dominance of the nomads.

During the war Moslem soldiers in French uniform became familiar figures in France. They were natives of northern Africa, more particularly Algerians. Side by side were other native soldiers in the uniform of the British army. These were from India, however, not from Egypt. With her great population Egypt furnished scarcely a soldier to the Allies. Algeria and Tunisia furnished according to my estimate—no official figures are available—several hundred thousands. It is true, of course, that political conditions are different in the two areas and furthermore that during the last years of the war conscription was in effect in Algeria. But it is probably true to say that the Algerians would have been mortally offended to have been left out of the greatest war in history. Certainly the part they played has helped our mutual relations. In the last analysis it is the response of the warlike spirit, a spirit to which the Egyptian is stranger. The atavisms that these two peoples represent are the converse of each other.

HOKKAIDO, THE NORTHLAND OF JAPAN*

By Wellington D. Jones
University of Chicago

Hokkaido (Yezo), the northernmost of the four larger Japanese islands (Fig. 1) is of peculiar interest to geographers because it is so strikingly different from the rest of Japan. The Japan we commonly think of is a land of long, hot, rainy summers and mild, rainy winters, a land with rice and silk and tea as characteristic crops, a land with a dense population and a highly developed agriculture that utilizes to the utmost the cultivable area. In so far as Japan really counts for much in the world it is like this, but Hokkaido is different.

Topographic Similarities with the Main Island

In topography the 30,000 odd square miles of Hokkaido are much like the rest of Japan, with relatively much hill and mountain area and little lowland plain. The mountains are for the most part neither high nor rugged, and, though there are numerous fine volcanic cones, which add a striking element to the scenery, especially in the southwestern peninsula, much of the mountain area is non-volcanic. The highest mountain in the island is Nutapkaushpe, 7,691 feet above sea level. The most extensive plains are the lowlands of the Ishikari, Tokachi, Nemuro, Teshio, and Kushiro. Of these the Ishikari Plain is by far the largest and most important. The coastal lowlands are narrow and of relatively little importance for cultivation. Most of the streams are swift and of practically no use for navigation except for small boats and rafts. The water power possibilities of some of these streams are considerable.

Contrasts Between Hokkaido and the Rest of Japan

In other respects than topography, Hokkaido presents a marked contrast to the rest of Japan. Its population is sparse, and agriculture is in its infancy. Much of its cultivable area is covered with virgin forest. And yet, though at present undeveloped and unimportant, the possibilities of Hokkaido are of real significance, for its area constitutes one-fifth that of all Japan, and its resources in proportion to area are not far inferior to those of other parts of that country.

The name Hokkaido, meaning "Northland," calls attention to that feature of the physical environment in which this island differs most markedly from

* In July of 1916 the author of this article spent ten days in Hokkaido, traveling about the island with Professor H. Tanakadate of the College of Agriculture of the Imperial University of Tohoku. Observations made at that time are correlated in this article with facts obtained from the rather scanty literature on Hokkaido.

the rest of the archipelago. The climate of the main island—excluding the northern portion—is similar to that of the Carolinas, in the eastern part of the United States cotton belt, whereas the climate of Hokkaido is much like that of central Wisconsin or of New England.[1] Perhaps the most striking expression of the difference is the comparative unimportance of the great food staple of the East. In place of rice, which occupies the largest acreage in the southern islands, peas and beans constitute the chief crop in Hokkaido.

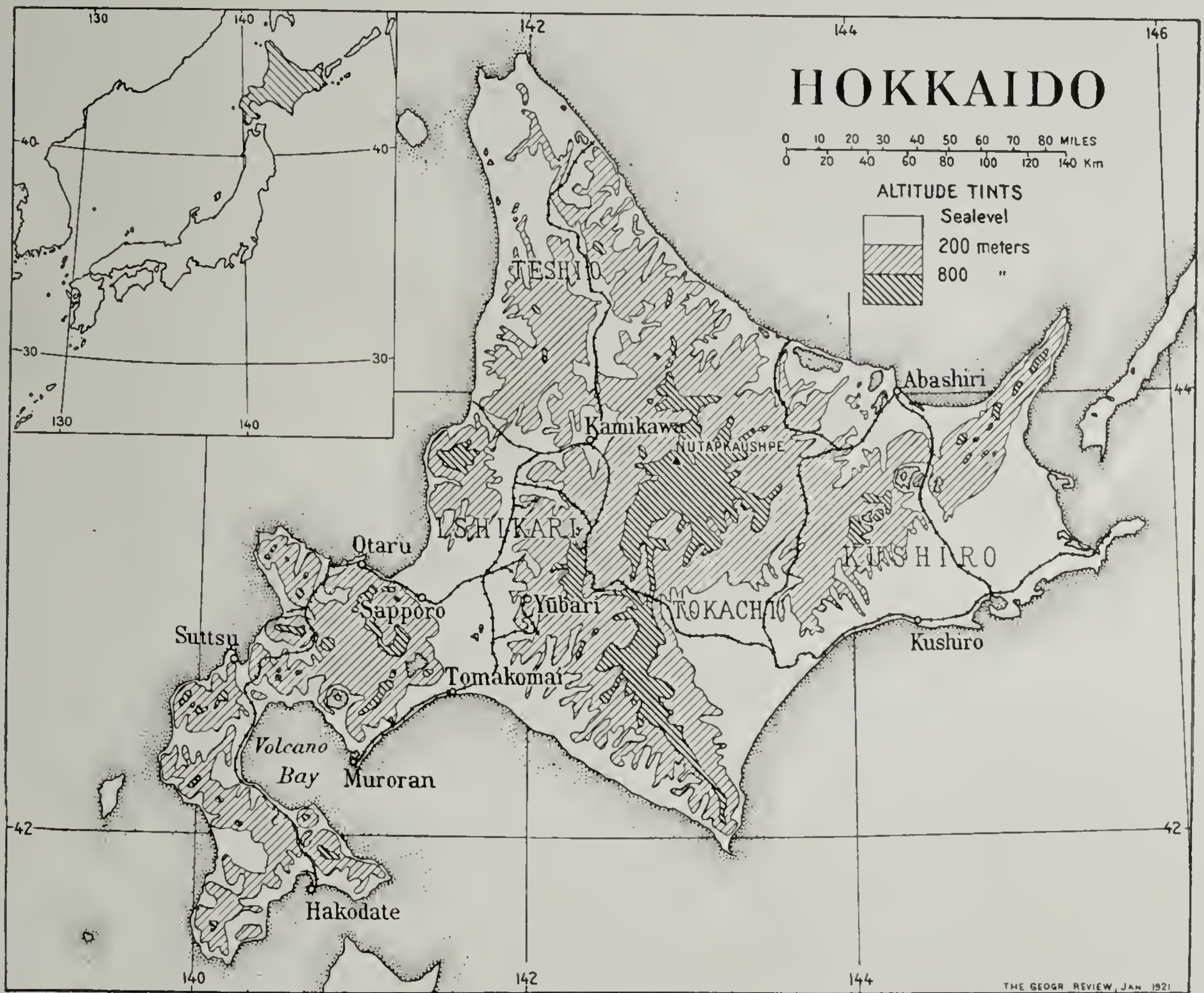

FIG. 1—Relief map of Hokkaido (scale 1 : 5,200,000) with inset showing relation to the rest of Japan.

Potatoes come second, three-fifths of the Japanese crop being grown in the northern island, where conditions are highly suitable. Cereals other than rice—oats, barley, maize, buckwheat, and millet—which are an important feature of the agriculture of the southern islands, are also of consequence in Hokkaido. But, whereas in the former they are grown as winter crops (except in the upland districts and except in the case of maize), in Hokkaido they are summer crops. The cooler summer climate of the northern island is again suggested in the growth of flax for fiber, a cultivation practically absent in other parts of Japan.

Of late years there has been much discussion about the possibilities of growing rice in Hokkaido. Until rather recently it was thought that rice

[1] See the note "The Climate of Japan" in the "Geographical Record" of this number of the *Review*.

would not mature in the short summers of the northern island. This idea was one of the causes of the reluctance of the Japanese to settle in Hokkaido and a partial explanation of the present sparse population there and the relatively undeveloped state of its resources. Within the last few years, however, it has been recognized that the interior lowlands enjoy warmer and longer summers than the coasts. In consequence there has been a rapid development of rice culture, particularly on the Ishikari Plain, so that at present there is a larger area in rice on the island than in any other cereal

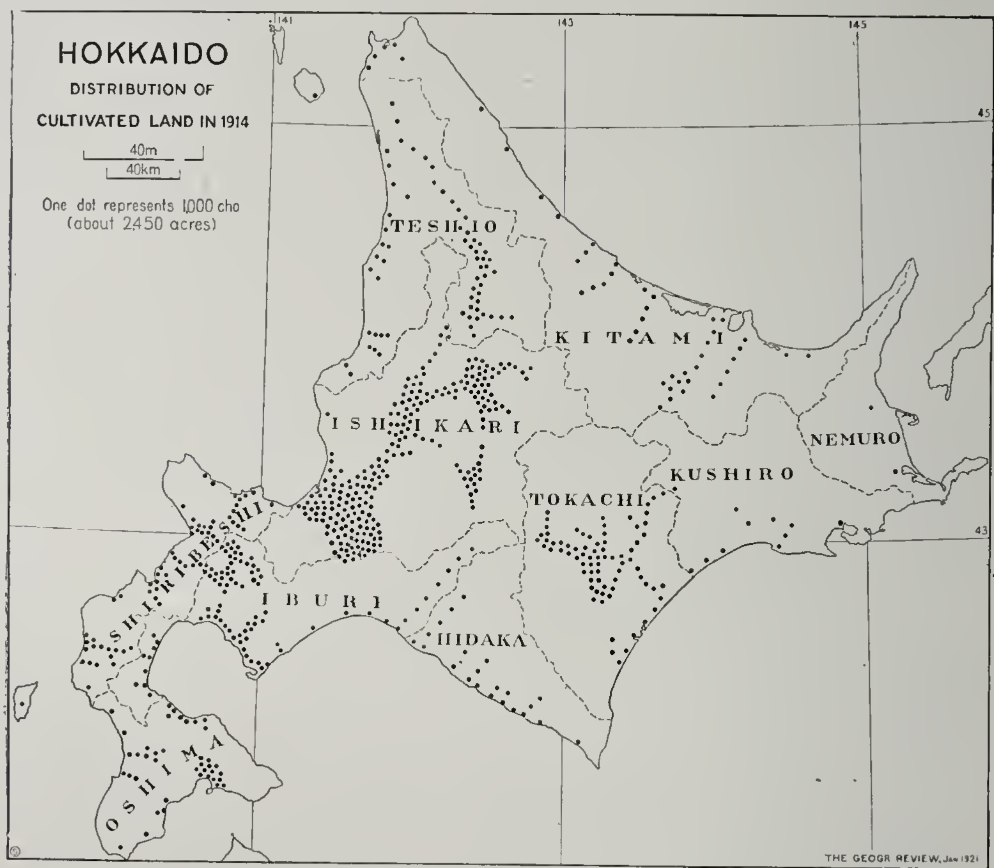

FIG. 2

except oats. It seems improbable, however, that rice will become and remain the dominant crop in Hokkaido. A large part of the cultivable area of the island seems climatically unsuited to the crop, and, even in the sections where rice can be grown, other crops will probably prove more profitable, for the returns are smaller and less certain than farther south.

Status of Agriculture

Another striking difference between Hokkaido and the other parts of Japan lies in the relative importance of agriculture, a difference, however, that will tend gradually to disappear. At present not more than half of the arable land of Hokkaido is used, and large sections of potentially high-grade farm land still remain under the primeval forest. Just what proportion of the total area of the island can eventually be cultivated is not known; but, in view of the fact that the general character of the topography and the soil

is much like that of the other Japanese islands, 15 per cent is probably a safe estimate.

Cultivation in Hokkaido is much less intensive than in "Old Japan." The average size of farms in the north is 9½ acres, whereas in the southern islands it is 2½ acres. The presence in the fields of standing dead trees that have been killed by girdling, and of many stumps, also suggests the less intensive use of the land, as well as the recent date at which it was cleared for cultivation (Fig. 3).

Table I—Area and Value of Important Crops in Hokkaido, 1917

	Area in Thousands of Cho (cho = 2.45 acres)	Value in Millions of Yen (yen = approx. 50 cents)
Total cultivated area	746.5	....
Beans and peas	171.7	23.6
Potatoes	76.1	13.3
Rice	63.9	17.2
Oats (1914)	63.2	4.2
Naked barley and barley (1918)	31.3	6.0
Millet	20.9	2.4
Maize	20.6	2.6
Flax	19.7	3.5
Buckwheat	18.4	1.5
Rapeseed	14.0	2.7
Wheat (1918)	10.7	2.0
Squashes	6.7	1.9
Radishes	5.5	1.4
Cabbages	2.9	1.0

From *Thirty-fourth Statistical Report of the Department of Agriculture and Commerce*, Japan.

The newness of the agricultural economy of Hokkaido is again reflected in the relatively greater importance of stock raising. In the old and densely settled parts of Japan there are few of the larger animals, and these are kept mostly for draft purposes. In Hokkaido the number of horses in proportion to the human population is comparatively large, and the raising of cattle for meat and dairy products has made a good start. In the sparsely populated northland there is a great need of draft animals to supplement human labor, while there is plenty of land available for grazing. Furthermore, the climate of Hokkaido is more favorable to the growth of forage plants than that of the southern islands, and some credit may be due also to the stimulus of American agricultural experts who were employed a generation ago to help in the development of the resources of the island. Yet, in spite of such favorable conditions, the number of cattle, while relatively superior to that of Old Japan, is very small. In the state of Wisconsin, where geographical conditions are much like those in Hokkaido, there was in 1914 an average

of somewhat more than one head of cattle per person, whereas in Hokkaido there was only about one head of cattle per 113 persons. The Japanese are not accustomed to eat meat and dairy products, and, until a better market for such products is developed either in Japan or in China, the number of cattle in Hokkaido probably will not nearly approach the number that the island could support.

The Fisheries

The first industry to develop in Hokkaido, and long the chief one, was fishing. The seas surrounding the island are rich in fish, and fishermen

Fig. 3—Field of beans in Hokkaido. The presence in the field of many stumps and standing dead trees suggests the less intensive use of the land.

from Honshiu early began to voyage northward in the summer season. Numerous coastal villages were established with a considerable population for the summer months of each year, but they were deserted during the long winter when their inhabitants returned south to a warmer clime. Gradually, however, certain of these villages, especially those on the southern and western coasts, became inhabited all the year round, and a little land was cultivated. Ultimately fishing gave place to agriculture and to the exploitation of the forest resources of the island. In spite of its relative decline, however, the fishing industry of Hokkaido today is more important than ever before, both as regards the number of people engaged in it, and the value of the products—50,000,000 yen (yen = 50 cents) average for 1917–1920. In fact, it seems clear that fishing will remain one of Hokkaido's chief industries.

Outstanding features of the industry are the large herring catch of the western coast, the cod catch of the Okhotsk Sea, and the annual run of salmon up the streams. The kelp harvest, which furnishes food sold both in Japan and in China, and the production of large quantities of fish manure

(by letting fish rot on the beaches) are also significant resources. Only a small part of the products of the Hokkaido fisheries is consumed on the island. The bulk of the catch is exported to the near-by markets in the densely populated parts of Japan and to China.

Numerous fishing villages along the coasts of Hokkaido add an extremely picturesque element to the naturally attractive landscape of the island. The typical village consists of a score or so of low, solidly built log houses, with roofs of rough-hewn shingles weighted down with many stones to withstand the gales. It possesses several sharp-prowed fishing boats that may be pulled up on the beach when not in use and that are launched for

Fig. 4—A terraced rice-field in Kiushiu, an example of the intensive agriculture of "Old Japan."

a trip by the united efforts of most of the inhabitants of the village. Not so picturesque or so conspicuous as these fishing villages, but of great importance as indicating the trend of things, is the number of scientific fish hatcheries and experiment stations.

Forest and Mineral Resources

Exploitation of the timber resources of Hokkaido did not become important until the 1890's or 1900's. Since that time, however, cutting has been rapid, and, though there remain considerable areas of forest untouched by the woodsman's ax, the not distant future will probably see a rapid decline in logging and lumbering. As usual in a new country logging methods are wasteful, taking only the best and leaving slashed and cut-over forests to disastrous fires, reminding one of early logging in Wisconsin or Michigan. The chief woods cut for lumber are oak and pine. The larger sawmills are near the mouths of the principal rivers, for most of the logs are driven down the streams, although now use is also being made of railroad transportation. The greater part of the lumber is exported either to the other Japanese islands or to the coast of China. Spruce is cut for use

in the pulp mills at Tomakomai (Fig. 5), on the southern coast of the island. These mills are said to be the largest of their kind in the Far East.

The forests of Hokkaido are of a very different type from those of the southern islands. The red pine and the broad-leaved evergreens, such as live oak and camphor which characterize the southern islands, are absent in Hokkaido, and in their place are the northern conifers and mixed hardwood and conifers. Beyond the difference in climate the relative proximity of Hokkaido to the Siberian mainland, whence certain tree species may

FIG. 5—A sawmill in Hokkaido. The logs are received and the lumber is shipped from the mill by rail.

have migrated, may be responsible in part for the difference in forest type between northern and southern Japan.

The coal of Hokkaido constitutes an important fraction of Japan's total coal resource. The deposits of northern Kiushiu are of somewhat greater magnitude than those of Hokkaido, but they are being exploited rapidly, so that the importance of the latter in the not distant future will be considerably greater than at present. The chief fields of the island are those of the Yūbari district, not far northeast of the port of Muroran. In this district mining is carried forward in vigorous fashion, with several thousand miners employed. The product is used on the railroads and in the steel mills at Muroran and sold as bunker coal. It is also exported to other parts of Japan and to the China coast. Of the 26,400,000 metric tons of coal produced in Japan in 1917, 3,700,000 tons were produced in Hokkaido.

The chief towns of Hokkaido are Hakodate on the southwestern peninsula, Otaru on the western coast, Muroran and Kushiro on the southern coast, and Sapporo, which is inland on the Ishikari Plain.

Fig. 6

Fig. 7

Fig. 6—The cool, foggy coast of Hokkaido. Note the sharp-prowed fishing boats which form the basis of the chief industry of the island.

Fig. 7—The coast of southern Kiushiu showing the fields of rice, the chief crop of the southern island.

THE SEAPORTS

Hakodate, with a population of about 100,000, is the oldest important town on the island. For a long time it was the chief port, and it is still a rival of Otaru, which now leads among the ports. As compared with Otaru, Hakodate has the advantage of being just across the straits from the main island. It is therefore the northern terminus of the ferry connecting the railroad system of Hokkaido with that of Honshiu, and it handles the mail and passengers to and from the mainland. Otaru, on the other hand, is nearer the largest productive area of the island, the Ishikari Plain (Fig. 2)

FIG. 8—The port of Kushiro at the mouth of the Kushiro River, showing the rafts of logs brought down the river to be sawed for export.

and so handles the bulk of the commerce of the island. Therefore, even though the harbor of Hakodate is excellent, with deep water and secure protection from storms, whereas that of Otaru has required considerable expenditure for deepening and for protective breakwaters, the importance of the latter port may nevertheless be expected to increase steadily. Otaru has growing exports of lumber, beans, coal, and fish and is the center of a thriving fishing industry. The situation of Otaru with reference to the coal fields of the islands and to the importation of iron ore from China or Manchuria would seem to favor the establishment of iron and steel mills somewhere in the vicinity.

Muroran, on the eastern side of Volcano Bay, has an excellent natural harbor and is the chief export port for Yūbari coal (see Fig. 1). The Tomakomai pulp mills also export through Muroran, and there is a timber trade of some importance. The iron and steel mills in the vicinity use coal from the Yūbari fields and ore from China and Korea. It has been suggested that Muroran may become a port of call and a coaling station for vessels trading between North America and eastern Siberia. Muroran has a promising future in trade and manufacturing, but it will probably never approach Otaru or Hakodate in importance.

Kushiro is the port of the southeastern coast. Logs rafted down the river are exported whole or sawn in mills near the town and exported as lumber. Sulphur and coal are also brought down the river from the interior and exported, together with quantities of fish. Kushiro has a tributary area that is less productive than that of Otaru, and it has a less favorable location with reference to trade with the mainland than Hakodate. As a port it will always be less important than either Otaru or Hakodate, its possibilities of development being perhaps on a par with those of Muroran. The harbor of Kushiro is of the river-mouth type and is only fair.

Table II—Foreign Trade of Certain Hokkaido Ports and of Kobe, 1917
(In millions of yen)

Port	Exports	Imports
Kobe	479.8	530.1
Otaru	11.2	.3
Hakodate	6.4	.9
Muroran	2.3	1.6
Kushiro	1.1	....

From *Annual Return of the Foreign Trade of the Empire of Japan*, 1918, Part I.

All of these Hokkaido ports, even Otaru, are relatively insignificant as compared with the chief ports of Old Japan. The accompanying table of foreign trade statistics (Table II) indicates that in this respect, as in most other phases of economic development, the northern island is very new.

The Capital

Sapporo, the capital of Hokkaido, is the chief city of the Ishikari Plain. Its political importance undoubtedly has had much to do with its growth to nearly 97,000 in 1913, but its geographical position in the largest and most highly developed agricultural area in the island, is chiefly responsible for its development. Thus, while the statement that "the city was artificially established by the government" is in a sense true, the causes of the growth of the city are far from "artificial."

In appearance Sapporo is very different from the cities of Old Japan. The cold and snowy winters of the northland do not favor the thin-walled paper and bamboo structures that are typical of most of Japan. Because of the climate some other type of building must inevitably have been developed even had there not been another influence at work. This other influence was the group of American educators, engineers, and scientists who were employed by the Japanese government about the time Sapporo was founded and who introduced into Hokkaido the New England type of solid structures well adapted to cold and snowy winters. The result of the

combined influence of climatic exigency and foreign suggestion is a type of building that is a curious mixture of Japanese and American, with elements of both but looking like neither (Figs. 10, 11). Another alien feature of Sapporo is the gridiron plan of wide streets, strangely in contrast with the narrow, crooked lanes of the typical Japanese city. Sapporo has a growing university, an agricultural college, and an agricultural experiment station, and the city is the educational as well as the political center of Hokkaido.

The Immigration Movement

The foregoing sketch of the possibilities of Hokkaido naturally raises the question as to why they have not been utilized to a greater extent. Why has the population remained so sparse in contrast with overcrowded southern Japan? [2]

The reasons are several. For one thing, the cold and snowy winters in the north prove repellent. The people of Old Japan are not used to building warm houses, to keeping fires to warm their houses, and to wearing heavy clothing to protect themselves against low winter temperatures, and apparently they do not wish to settle where they must acquire such habits. This is a very real deterrent to settlement, as is attested by the repeated assertion of the fact by Japanese.

A second cause for the unwillingness of the Japanese to settle in Hokkaido was the fact that it was thought that rice could not be grown there. The staple crop in Old Japan is rice, and a plan of life with rice omitted is highly unattractive to the Japanese. Since it has been discovered that certain varieties of rice can be grown in parts of Hokkaido immigration to the island has been somewhat more attractive.

A third cause for the small immigration in Hokkaido has been and still is the existence of the rather hard and primitive conditions that belong to frontier communities. The clearing of the forest is a battle in itself. The long struggle which follows, in grubbing out the stumps from the fields, requires a quality not yet developed in most Japanese. The privations, both physical and social, which pioneers must endure, are numerous and stern and do not appeal to the men who have lived their lives in the highly organized communities of Honshiu, Kiushiu, or Shikoku.

Still another and somewhat less tangible cause for the Japanese not settling in Hokkaido is their love for the home district, where their ancestors have lived for generations. This is the more natural in view of the social organization, the religious belief, and the moral code of the Japanese.

In the 1880's the Japanese government began serious efforts to attract immigrants to Hokkaido and to exploit the resources of the island. American scientists, engineers, and educators were employed and for several years were actively engaged in establishing agricultural experiment stations,

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[2] See the population maps in the article "The Distribution of People in Japan in 1913," by Mark Jefferson, *Geogr. Rev.*, Vol. 2, 1916, pp. 368–372.

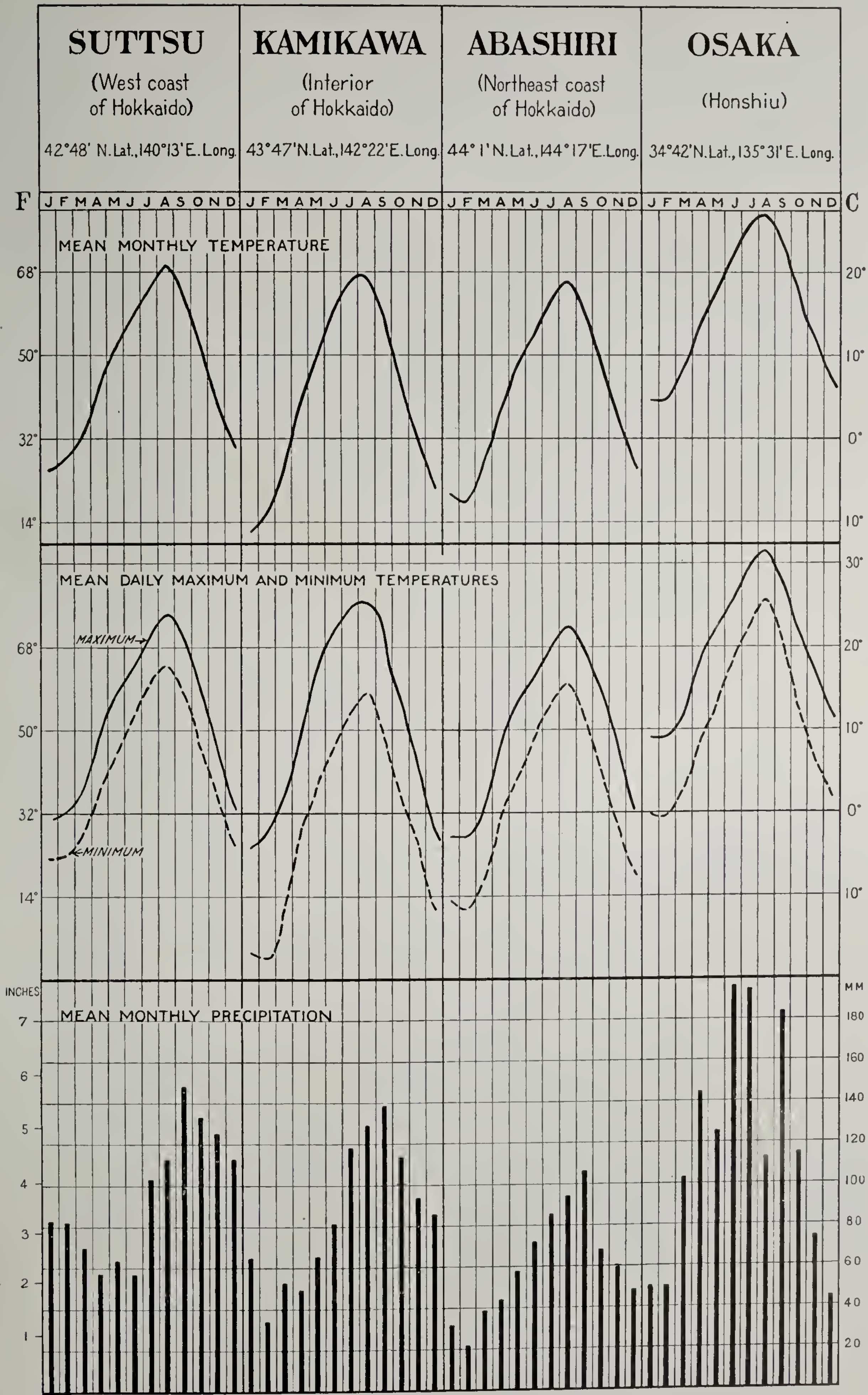

FIG. 9—Compare with the map of the Climatic Zones of Japan in the "Geographical Record."

Fig. 10

Fig. 11

Fig. 10—The substantial frame buildings of Hokkaido are the result of climatic conditions plus the foreign influence introduced by the group of American experts employed by the Japanese Government.

Fig. 11—A farmhouse in south central Honshiu. The thin-walled paper and bamboo buildings typical of Old Japan present a marked contrast to the solidly built structures shown in Fig. 10.

FIG. 12

FIG. 13

FIG. 12—Frontier conditions in Hokkaido. The mountains are covered with virgin forest while the isolated farmhouses are surrounded by partially cleared fields.

FIG. 13—A prosperous farm community in Old Japan with its carefully cultivated fields. The lower slopes of the hills are terraced for cultivation and the upper slopes are planted to forest.

making geological surveys, building railroads, and founding schools. The government offered various inducements to immigrants, such as cheap land, free transportation, and so on. The results, however, were disappointing, for immigrants did not come in as large numbers as had been hoped for, and many who did come returned later to their old homes in the south.[3] Gradually, however, the number of immigrants has increased, and in 1914 some 320,000 more people went to Hokkaido from other parts of Japan than left the island. In view of the fact that the total population of the island in 1914 was something less than two million, this was a notable increase. If this rate of addition be maintained the population-absorbing capacity of the island will probably be reached in a quarter of a century.

The influence of frontier conditions in Hokkaido on the habits and character of the immigrants from other parts of Japan is marked. The people have a certain kind of energy, a briskness of manner, and an upstanding independence of spirit that are much less noticeable in the inhabitants of the older and more highly organized communities of the southern islands. These differences are of a sort not unlike those between the people of the eastern part of the United States and those of the West. In the case of the United States the reflex influence of the frontier on the older communities was stimulating and helpful in the extreme. A similar reflex influence of Hokkaido upon the rest of Japan can be expected, although it is not likely to be as important as it was in the case of the United States, for in the United States the new regions were large and rich as compared with the old, whereas in Japan this is not the case.

Until Hokkaido becomes much more densely populated than now it will continue to be an increasingly important source of foodstuffs and raw material for manufacture for the industrial districts of southern central Japan. Its resources of agricultural land, forests, minerals, and fisheries are great enough to support a much larger population than it has at present and still leave a considerable surplus of products for export. Eventually, however, there will come a time when the island will have a population dense enough to require all or most of its products. But, however highly developed it becomes, Hokkaido never will be like the islands to the south. Fundamental differences in physical environment will be reflected inevitably and permanently in a different economic development, so that Hokkaido will always be the "Northland of Japan."

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[3] See the article "Japanese Colonial Methods," by E. C. Semple, *Bull. Amer. Geogr. Soc.*, Vol. 45, 1913, pp. 255–275.

THE NATURAL REGIONS OF THE FRENCH ALPS

By Raoul Blanchard
University of Grenoble

The Alpine region is one of the parts of France of which the geographical study is furthest advanced. Completion of the geological map on the scale of 1:80,000, which event coincided with the foundation of the Institut de Géographie Alpine at the University of Grenoble, afforded the base for the prosecution of a wide range of geographical studies. Much has already been accomplished,[1] and thus it is now possible to present the major geographical features of the French Alps, an extensive region lying between the Lake of Geneva and the Côte d'Azur, a length of 300 kilometers, and the plains of the Rhone and the Italian frontier, a breadth of 150 kilometers. Here, however, in place of discussing the general features of this portion of the Alpine chain we shall endeavor to give some idea of the varied geographical aspects within the region itself.

The Fundamental Distinction between North and South

The outstanding feature of the regional classification of the French Alps is the contrast presented by the northern and southern portions of the chain. Insistence is laid upon this distinction, for too often one still meets the old division into Alps of Savoy, Dauphiné, and Provence, based on purely historical distinctions long since vanished.

The Climatic Boundary Line

The capital distinction between north and south rests in the climatic characteristics of the two sections, the one exposed to oceanic influences, the other falling within the Mediterranean régime. The Northern Alps, allowance being made for the effects of altitude, enjoys a climate essentially similar to that of the adjacent regions to the west and north—the plain of the Saône, the Central Plateau, the Jura. The temperature is rather low in winter, the summer is warm in spite of its humidity; rains are regularly distributed and abundant, with maxima in the summer and autumn. It may be described as the "maize" type of climate, and in fact cultivation of this cereal along with the mulberry is common in all the valleys of the Northern Alps where the altitude does not exceed 500 meters. The distinctive feature of the climate is the abundant precipitation, both rain and snow, in virtue of the relief and exposure. On the western side

[1] Published for the most part in the *Recueil des Travaux de l'Institut de Géographie Alpine* (1913–1919) and its successor the *Revue de Géographie Alpine de Grenoble* (1920–).

of the massif of Chartreuse the annual precipitation amounts to between 3 and 4 meters; 9 to 10 meters of snow falls annually at Tour in the valley of Chamonix (altitude 1,400 meters).

On the contrary the southern Alps present—and in a degree little affected by altitude—all the climatic features of the Mediterranean region, in particular the characteristic drought. Temperature is higher; evaporation is more active. The northern winds, of which the mistral is typical, bring no precipitation but on the contrary are avid absorbers of moisture. Rains are rare and correspondingly violent. There are two distinct dry seasons, that of winter and more markedly that of summer, the latter lasting six months. Snows also are scant. On the other hand, the autumn rains fall in tempestuous showers that score the land and swell the torrents with startling suddenness.

Structural Differences

To this climatic contrast must be added the structural differences between the two parts of the chain. In the south the trend of the relief is complicated by the effects of two directions of folding, the one Pyrenean, the other Alpine. In the north the arrangement of folds is simple and regular. As is well known, besides simple folding and faulting a large part of the Alpine structure as a whole has been accomplished by horizontal displacement, especially in the central and eastern Alps. Overthrusting is far less important in the French Alps,[2] but even here there is a significant distinction between north and south in this regard. Although the masses of overthrust material (*charriage*) become more abundant as one proceeds to the northeast, in the northern section of the French Alps west of the central massifs they occur only in the little region of Chablais. In the south they occupy an extensive area in the upper Durance basin.

Furthermore, there is dissimilarity between north and south in the nature of the rocks. The south exhibits to a far greater degree than the north a complex of hard and soft rocks.

Effects of Climatic and Structural Differences

These differences of climate and structure are reflected in all other geographical phenomena. While the relief of the northern section is simple, harmonious, and already in a well-advanced stage, that of the south is irregular and disordered. The highest summits of the southern section fall far short of those of the north, yet the mean elevation is not greatly inferior and penetration is far less easy. Glaciers are naturally less well-developed; the extent is only about one-tenth that of the northern section, and the streams are characterized by irregularity and paucity of discharge

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[2] See Raoul Blanchard: La structure des Alpes, *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 3, 1915, pp. 163–227. Grenoble.

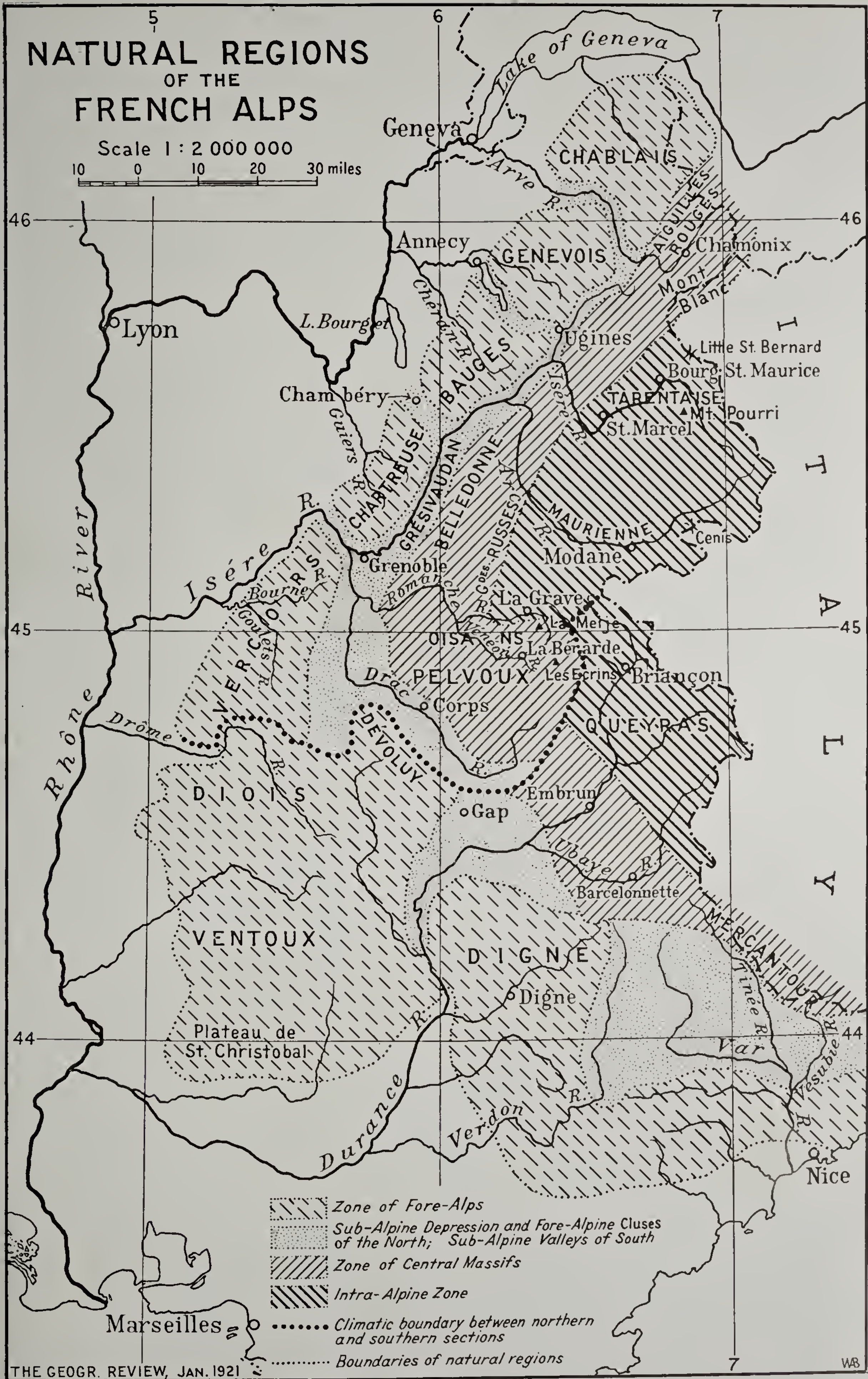
NATURAL REGIONS
OF THE
FRENCH ALPS
Scale 1 : 2 000 000
10 0 10 20 30 miles
Lake of Geneva
Geneva
CHABLAIS
Arve R.
AIGUILLES ROUGES
Chamonix
Mont Blanc
Annecy
GENEVOIS
Lyon
L. Bourget
Chéran R.
BAUGES
Ugines
Little St. Bernard
Bourg St. Maurice
TARENTAISE
Mt. Pourri
St. Marcel
Chambéry
Guiers R.
CHARTREUSE
GRÉSIVAUDAN
BELLEDONNE
Isère R.
MAURIENNE
Cenis
Modane
Rhône River
Isère R.
VERCORS
Bourne R.
Goulets R.
Grenoble
Romanche R.
COES. RUSSES
La Grave
La Meije
La Bérarde
OISANS
Vénéon R.
PELVOUX
Les Ecrins
Briançon
Drac R.
Corps
QUEYRAS
Drôme
DÉVOLUY
DIOIS
Embrun
Gap
Ubaye R.
Barcelonnette
VENTOUX
DIGNE
Digne
MERCANTOUR
Tinée R.
Plateau de St. Christobal
Var
Vésubie R.
Durance
Verdon R.
Nice
ITALY
Zone of Fore-Alps
Sub-Alpine Depression and Fore-Alpine Cluses of the North; Sub-Alpine Valleys of South
Zone of Central Massifs
Intra-Alpine Zone
Climatic boundary between northern and southern sections
Boundaries of natural regions
Marseilles
THE GEOGR. REVIEW, JAN. 1921
WB
5
6
7
46
45
44

FIG. 1

where those of the north have an abundant and steady flow admirably adapted to industrial purposes.

Under the influence of copious and regular rains the vegetation of the Northern Alps is profuse and fresh. Below the 2,000-meter line forest clothes the slopes, tending to occupy all spaces undisputed by man. Above, to the limit of vegetation at the 2,500-meter line, extend the alpine meadows. In the south the struggle for life is harder. The disseminated vegetation has a meager aspect. In the characteristic forms of *garrigue* and *maquis* are signs of adaptation to drought. On the slopes grass frequently alternates with bare rock.

Human life reflects these conditions. The north is a region of flourishing agriculture based especially on cattle raising. This is the cow country. The drier south is the great sheep domain. In the south irrigation is necessary: insufficiency of water limits cultivation on the characteristically ravined slopes. The length and difficulty of routes across the chaotic mountains restricts traffic, which on the contrary circulates freely along the ample valleys of the north. The same circumstances in combination with the great hydro-electric resources favor industry in the north as against the south. The sum total of influences is reflected in the population densities—19 people per square kilometer in the south, 55 per square kilometer (including the large towns) in the north.[3]

The dividing line between north and south is very clear. It is the remarkable climatic boundary that runs from the Drôme to the Durance by the passes and crests forming the southern boundary of the Isère basin.

The Northern Alps

Simplicity of structure and relief and the resultant well-developed hydrographic system permit the distinction of the northern Alps into four groups of natural regions parallel to the arc of the chain—the Fore-Alps, the Sub-Alpine Depression, the Central Massifs, and the Intra-Alpine Zone.

The Northern Fore-Alps

In this region are included the outlying massifs that owe their origin to folding in place in front of the central massifs, exception being made of Chablais where the folds of local origin are buried under masses that have been overthrust from the southeast. The distinctive features of the Northern Fore-Alps are the more clearly revealed towards the west where the massifs overlook the exterior plains and towards the east where they tower still more boldly over the Sub-Alpine Depression. The regular folds of the well-known Jura type, formed in alternate limestones and marls, have been modeled by erosion into lines of white cliffs and longitudinal valleys. The crest lines show none of the typical Alpine forms—no needles,

[3] See J. Robert: La densité de population des Alpes françaises d'après le dénombrement de 1911, *Rev. de Géogr. Alpine*, Vol. 8, 1920, pp. 5–124; noted in the *Geogr. Rev.*, Vol. 10, 1920, p. 345.

no isolated summits—but appear as veritable fortress walls, bastions, high platforms terminated by rude precipices, across which the streams have cut their way by deep gorges, the famous *cluses* of Chéran, the two Guiers, the Bourne, and the Goulets.

Although not greatly elevated (the summits rarely surpass 2,000 meters), these westward-lying heights get the full benefit of exposure to the humid westerly winds and receive the heavy rains and snows to which they owe their wealth of vegetation. This is indeed the country of beautiful meadows and splendid forests (beech and fir), the domain of grass and tree. There

Fig. 2—In the Northern Fore-Alps. The limestone cliffs of Mont Pennay in the Bauges massif.

is little land under cultivation, and even that is steadily diminishing before the meadows. Cattle raising has become almost the exclusive interest of the population, exception being made of the exploitation of the forests.

But the interiors of these rich mountain lands are not easy of access. Despite the marvelous defiles of the *cluses* few railroads approach them. Industrial activity is confined to the periphery, and the population of the interior remains sparse, declining from the north to the south as the means of communication become poorer. The average density of the region is 27 per square kilometer, ranging from 39 in Chablais to 13 in Vercors.

The continuity of the Fore-Alps is broken by great valleys which cross it. Some, such as the Arve and the Isère, are occupied by streams draining to the Rhone. Others, as the *cluses* of Annecy and Chambéry, which preserve traces of former glacial erosion in the still lake-filled depressions

of Bourget and Annecy, are today streamless. Broad and deep, these valleys serve as mountain gateways. Commanding entrance and exit here are the important Alpine towns, Annecy, Chambéry, Grenoble. Ease of communications, industrial development, richness and variety of agri-

FIG. 3—Gorges in the Chartreuse massif, Northern Fore-Alps.

cultural resources distinguish the great *cluses* from the mountains of the Fore-Alps in which they are cut. They may indeed be considered as prolongations of the Sub-Alpine Depression.

THE SUB-ALPINE DEPRESSION

Separating the Fore-Alps from the Central Massifs is a zone of much lower altitude. This Sub-Alpine Depression is a monoclinal trench eroded

by riverine and glacial action in the band of soft schists, lying west of the crystalline massifs. It is constituted by a series of valleys of capture by which all the streams of the Northern Alps save the Arve have been brought into the trunk system of the Isère. At Grenoble, where the Isère crosses the Fore-Alps, the depression is very deep (altitude 200 meters). Width and height however vary greatly: in places the floor of the depression attains an elevation of 1,000 meters.

The Sub-Alpine Depression is a varied region. It includes true plains, broad and low as that of Grésivaudan, plateaus, and elevated basins. But, whatever the altitude attained, it is always enclosed by sheltering mountains much more elevated. Everywhere it offers man a fertile soil, the product of the disintegration of the soft rocks enriched by river alluvium and glacial deposition. The agriculture here practiced is of the type of the extra-Alpine plains, but under these exceptional conditions of soil fertility and shelter it offers possibilities of greater diversity and successful prosecution. The vine perhaps claims first place, followed by other fruits. On the alluvial soils cereals yield abundantly, and tobacco and beets flourish. Industry also finds conditions favorable. There is a plentiful labor supply which has, for instance, permitted the development of the famous glove manufactory of Grenoble. Local raw materials, to which may be added the fuel resources (anthracite) of the near-by Central Massifs, have led to the establishment of paper and pasteboard mills and the manufacture of lime and cement. The most notable feature of industry, however, is the use of hydro-electric power. The "white coal" industry began here in 1868; the technique of transmission was mastered in 1884; and today the great factories of the Sub-Alpine Depression, including that of Ugines which employs 3,000 hands, utilize 230,000 horse power.[4]

The depression is the vital artery of the French Alps. All the major routes of communication run for shorter or longer parts of their courses along the depression, which is strung from end to end with a succession of big villages, towns, and little market centers. The density of population averages 54 per square kilometer and in Grésivaudan, the most densely populated part of the French Alps, rises to 196.

The Central Massifs

There is a profound contrast between the broad trough described above and the barrier of high massifs which dominate it to the east, mighty mountains including the highest summits of the chain, Mont Blanc (4,810 meters) and Les Ecrins (4,103 meters). These massifs represent ancient Hercynian masses buried under more recent sediments and uplifted by the mountain-building movements of Tertiary time into a broken arc. Here the arrangement is in two parallel lines, the one (exterior) extending

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[4] For details see R. Blanchard: L'industrie de la houille blanche dans les Alpes françaises, *Ann. de Géogr.*, Vol. 26, 1917, pp. 15–41.

Fig. 4—In the Sub-Alpine Depression, plain of Grésivaudan (Isère valley). Grenoble and the chain of Belledonne (Central Massifs).

Fig. 5—In the Sub-Alpine Depression. Valley of the Drac at Corps. In the background L'Obiou, a summit of the Fore-Alps (massif of Dévoluy).

from Aiguilles-Rouges to Belledonne, the other (to the east) from Mont Blanc to Grandes-Rousses, the two meeting in the great crystalline mass of Pelvoux. The effect of pressure against these resistant cores has been to lift them to a great elevation, and they still maintain a great comparative height because of the effective resistance to weathering offered by the hard rock. Here are the usual forms seen in lofty mountains exposed to the active forces of erosion, subaerial and glacial,—a mass of serrated peaks, needles, and teeth, rising above the cirques and the troughlike valleys. Here one finds over half the glaciers of the French Alps (about 260 square kilometers) and among them the great glaciers of Mont Blanc, the Boissons, the Mer de Glace, descending to a level of nearly 1,100 meters and bringing the exotic splendor of their blue *séracs* into the midst of the verdure of forest and meadow.

This lofty zone, of which large areas are covered permanently or seasonally with ice and snow, is a barrier to man. It is of course a region of predilection to the alpinist, and in the recesses of the proud massifs are situated some of the chief tourist centers of the Alps, such as Chamonix and La Bérarde. But otherwise its resources are few. They are limited to such agricultural possibilities as are offered by the synclinal valleys pinched between the crystalline masses, the valley of Chamonix, the plain of Oisans, or to the exploitation of the forests and the pastures in the less elevated zone below the massif of Mont Blanc. The hydro-electric power from the streams is used only in the Sub-Alpine Depression or in the Intra-Alpine Zone. These massifs then are primarily a zone of isolation. Fortunately, however, the barrier is crossed by three passageways, the gorges cut by the Upper Isère, the Arc, and the Romanche, which though narrow afford practicable communication between the Sub-Alpine Depression and the Intra-Alpine Zone.

The Intra-Alpine Zone

Behind the central massifs are piled the great overthrust sheets so characteristic a feature of the Swiss Alps, formidable thicknesses of sediments from the depths of the Alpine geosyncline, gneisses and lustrous schists (phyllites), and towards the west sediments of more varied character and an origin less deep, sandstones, schists, limestones. Naturally the relief modeled upon these sheets is greatly varied in form and altitude. There are deep-sunk basins and steep-walled valleys, massive mountains and peaks most marvelously chiseled. In Tarentaise the floor of the Isère valley is only 800 meters above sea level at Bourg St. Maurice near the frontier, and the graceful pyramid of Mont Pourri overlooking it attains an altitude of 3,788 meters. In Oisans the Meije rises 2,500 meters above the basin of La Grave.

The contrasts between other geographical features is correspondingly accentuated. The closely sheltered basins are less well-watered. Not one receives as much as a meter of precipitation a year. The forest is less

extensive than in the western region and of a different facies: the larch, a tree thriving in drier and sunnier areas, replacing the spruce and fir. The alpine meadows occupy a more elevated zone than in the Central Massifs, and cultivation likewise climbs higher, here and there attaining a height of 2,000 meters. The lower slopes of the deep, sheltered valleys are limited to the more delicate cultivations: the vine is found at elevations of 1,000 meters. Thus the inhabitant of the zone finds highly varied agricultural resources—vineyards and orchards, fields and forests, alpine

FIG. 6—Glacial trough of Vénéon, massif of Pelvoux.

pastures—at his disposition, and he makes use of them all by becoming a veritable nomad. In the winter even as well as in the fine season he is on the move passing from stage to stage: when he is no longer needed in the vineyards he occupies an alpine châlet in the zone of high pastures; when cold drives him thence he returns by successive steps to the valley.

As in the Sub-Alpine Depression industry is correspondingly developed. The Intra-Alpine Zone utilizes 570,000 horse power, about half the hydroelectric force furnished by the French Alps. The greater part is employed in electro-chemical and electro-metallurgical industries. Similarly, ease of communication is another favorable factor. The zone is the highway of Franco-Italian traffic which makes use of the passes of the Little St. Bernard and Mont Cenis and of the Paris-Turin railway.

Of old these various favoring circumstances led to a fairly considerable density of population and promoted the growth of little independent

civilizations that were in effect mountain republics (Maurienne, Tarentaise, Oisans) comparable to the forest cantons of Switzerland. Today the population density of lower Tarentaise is 44 per square kilometer, of lower Maurienne, 50; and the civilization of this high mountain region remains the most distinctive of the four natural regions of the French Alps.

The Southern Alps

Broader, and of more complex structure, the southern section of the French Alps presents a much more confused relief than that of the north, and the natural regions are correspondingly less clearly defined. A continuation of the four regions of the north can indeed be recognized, but their physiognomy is modified and the relations between them are different. While the Fore-Alps here occupies a relatively enormous area, the Intra-Alpine Zone is reduced, tapering out to the verge of disappearance. Between the Central Massifs are intercalated mountain ranges of dissimilar character; the Sub-Alpine Depression gives place to another regional type—the Sub-Alpine valley.

The Southern Fore-Alps

South of Vercors the folded Fore-Alps become increasingly broad at the expense of the Central Massifs which bend sharply towards the southeast. Instead of the simple folding of the northern Fore-Alps, we have here sequences of short folds pertaining to two systems of different age and direction. Furthermore, the constituent rocks are less homogeneous than those of the north and consequently have suffered more under diastrophism and subsequent weathering. Where the black marls and yellow clays predominate and the massive white limestones are rare, erosion has powerfully modified the original relief, excavating a series of little basins from which the waters drain by picturesque defiles.

The Southern Fore-Alps are much drier, a feature specially marked in the valleys. At the bottoms of the basins are irrigated fields, watered meadows, and vineyards; on the suitably exposed slopes the more delicate fruit trees. Under shelter the olive is cultivated in a zone extending right across the region. The upper slopes, however, support only a meager brushwood including characteristic aromatic plants and affording pasturage for sheep and goats. These massifs are the poorest and least populated part of the Alps. The average density is 16, falling to 12 in the massif of Digne.

Furthermore, in spite of their moderate altitude these massifs constitute a true wall isolating the southern Alps from the exterior. No ample valleys give access across them as is the case in the north. The Verdon, for instance, issues from the Fore-Alps by a canyon so narrow that it has been followed by but a few explorers and by these only at the risk of life. The

Fig. 7

Fig. 8

Fig. 7—Intra-Alpine Zone of the North. The station of Modane (Maurienne) close to the Italian frontier.
Fig. 8—In the Intra-Alpine Zone of the North, the *verrou* of St. Marcel (Tarentaise). Hydro-electric establishment in the foreground.

Durance alone describes a valley broad enough to be termed a plain, and it is by this open highway that all communication is effected between Provence and the Alps. With its hydro-electric establishments and its flourishing agriculture the Durance might rather be regarded as the equivalent of the Sub-Alpine Depression of the north.

The Sub-Alpine Valleys of the South

The Sub-Alpine Depression disappears simultaneously with the break in the Central Massifs, that is on the southern border of Pelvoux. In place of that long corridor serving all the passages of the mountain are a series of transverse compartments terminating most frequently in a *cul-de-sac.* Only in the region of Gap, where a domal structure is developed and where the softness of the rocks has facilitated erosion, is there a depression of any continuity; and this peripheral depression is, as it were, a turntable of communications in the southern Alps. But the valleys of the Verdon, the Var, the Tinée, and the Vésubie are separated from one another giving only onto very elevated passes. Few parts of the Alps are more isolated. a striking contrast with the corresponding region of the north.

On the other hand, these valleys are much better watered than the Fore-Alps. On the slopes are fine forests, larch and pine mingled with spruce; the lower slopes above the olive groves are adorned with superb chestnuts. The raising of cattle as well as sheep is carried on. The water courses are well fed, and industry has commenced. The works under way will provide for 150,000 horse power in the near future, destined principally for the Côte d'Azur. The favorable features increase as approach is made to the Mediterranean. The density of population, only 10 per square kilometer along the Verdon, rises to 27 in the valley of the Vésubie.

The Central Massifs

Further contrasts with the Northern Alps appear in the southern continuation of the zone of Central Massifs. The Hercynian masses which constitute these massifs disappear south of Pelvoux to reappear to the southeast in the massif of Mercantour which with its bold peaks, cirques, and little glaciers recalls the great ranges of the north. The hiatus between Pelvoux and Mercantour is filled in by a great mass of Flysch sediments, beds of sandstones and schists inclined towards the west and supporting here and there limestone fragments that give a characteristic contour to these mountain summits. Yet contrariwise to the north these mountains do not constitute a barrier. Across the little-resistant surface the upper Durance and the Ubaye have worn down the Flysch to the underlying very soft black marls and have excavated basins therein, as those of Embrum and Barcelonnette, sites for settlement and passageways permitting access to the Intra-Alpine Zone.

Fig. 9

Fig. 10

Fig. 9—In the Southern Fore-Alps. Gorge in Diois.
Fig. 10—House types at Queyras. Intra-Alpine Zone of the South. Altitude 2,000 meters.

FIG. 11

FIG. 12

FIG. 11—In the Sub-Alpine Valleys of the South. Entrance to the gorges of the Verdon.
FIG. 12—In the Sub-Alpine Valleys of the South. The lower Tinée.

FIG. 13

FIG 14

FIG. 13—In the Central Massifs of the South. A typical basin in the Flysch of Embrunais.
FIG. 14—In the Central Massifs of the South. A basin in the Flysch (soft black marls) of Ubaye.

Fig. 15—Briançon, a town of the Intra-Alpine Zone of the South.

Intra-Alpine Zone

Of the four divisions of the southern Alps the Intra-Alpine Zone is the one most closely resembling the corresponding zone of the north. In the great thickness of overthrust folds it exhibits the same diversity of hard and soft rocks and the same variety of forms—ample basins deep as that of Briançon, longitudinal valleys of notable dimensions, transverse defiles whose floors are interrupted by the *verrous* (barriers of hard rock) characteristic of many glaciated Alpine valleys, high valleys, broad and open with gently sloping sides. Dryness is pronounced because of the distance from the Mediterranean. At Briançon is registered the smallest rainfall in the French Alps, 587 millimeters. Dryness and clearness of the air in this elevated region, so sheltered and so sunny, make it one of the most salubrious spots in Europe.

The altitude is considerable. Although the summit levels rarely surpass 3,000 meters, the mean elevation of the zone is greater than that of the north—a fact indicative of the less advanced stage of evolution of the relief. Here are situated the most elevated towns and villages of the French Alps. Here cultivation is carried on at the greatest elevations, and the upper limit of the forest likewise attains its highest level (2,500 meters). However, these lands are but ill-exploited. Isolation has retarded agricultural progress which remains based on polyculture and the extensive raising of sheep. This is the part of the French Alps where population has had its most rapid decline in consequence of extensive emigration both internal to Marseilles and external to Mexico and South America.

On either side of the climatic line dividing the French Alps into northern and southern sections profound differences are exhibited by the respective regions, always to the disadvantage of the southern section, less open, less penetrable, less "humaine."

MACKENZIE RIVER DRIFTWOOD*

By E. M. Kindle
Geological Survey of Canada

All explorers who have an acquaintance with the Arctic coasts of America are familiar with the driftwood which in many places encumbers the shore line. Along many parts of the Arctic coast of Alaska and Canada vast quantities of forest débris consisting largely of good-sized logs and trees are piled up on the beach where the adjacent land affords nothing in the shape of timber larger than the Arctic willow, which seldom grows higher than a man's head.

Sources of Driftwood on the Arctic Coasts

The *Fram* expedition collected 40 samples of the drift logs from the coasts of the Arctic Archipelago, and these have been determined by Dr. Ingvarson who recognizes three main sources for the wood.[1] The first is the Yenisei and Lena Rivers of Siberia, the second is the St. Lawrence, and the third is the coast of Norway. The Mackenzie River is not mentioned. In the writer's opinion it is second only to the Siberian rivers as a source of Arctic coast driftwood, and he here records his own observations concerning it.

Driftwood on the Mackenzie

One might easily spend a single season on the Mackenzie, as the writer did in 1917, without learning that it furnished a very large amount of driftwood to the Arctic coast. During that season the driftwood seen consisted of occasional floating trees or widely deployed trains of forest débris. The *voyageur* sometimes utilizes one of the larger trees which still retains the branches, to make progress against an upriver wind. The deeply submerged branches cause the strong subsurface current to bear such a tree and any canoe which may be attached to it into the teeth of an upriver breeze as effectively as the underwater sail expedient, which is often resorted to when a floating tree is not available. Even in fair weather the floating tree is often made use of to save time for the *voyageur* on the Mackenzie. By lashing to a suitable tree he can cook his meals while proceeding on his way. If for any reason night travel seems desirable, the canoe may be secured to an Arctic-bound tree at bedtime and an undisturbed sleep obtained.

The relatively small amount of driftwood seen on the Mackenzie in 1917 is due to the fact that flood conditions did not occur on any of its tributaries

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* Published with the permission of the Director of the Geological Survey of Canada.

[1] Fredrik Ingvarson: Die Treibhölzer auf dem Ellesmere-Land, in "Report of the 2nd Norwegian Arctic Expedition in the *Fram*, 1898–1902," Vol. 3, No. 24, pp. 1–57, Christiania, 1911.

Fig. 1

Fig. 2

Fig. 3

Fig. 1—Driftwood on the Mackenzie River near Old Fort Good Hope.
Fig. 2—Area kept free of forest by ice action. Northern bank of the Great Bear River above Mt. Charles.
Fig. 3—View of ice ramparts on the Great Bear River above Mt. Charles, looking upstream. The rampart on the far shore has an average thickness of about 20 feet.

that year, and though a great carrier of driftwood the Mackenzie is not itself a great producer. The writer has elsewhere remarked that the vast quantity of driftwood carried by the Slave and its tributaries ends its northward journey in Great Slave Lake.[2] In the same place he has pointed out some of the contrasting features between the Mackenzie and such streams as the Peace and Athabasca Rivers which materially affect the relative amounts of driftwood produced by them. Because of the comparatively straight course and the frequency of boulder-paving the Mackenzie—except in the delta—takes from its own banks a relatively small toll of trees. By far the greater part of the driftwood which it bears to the Arctic Ocean comes from its western tributaries. Great Bear River, the only large eastern tributary, receives its crystal clear and very cold water from Great Bear Lake, which retains the driftwood as well as the silt which enters its basin.

Driftwood and Ice Jams on the Great Bear River

Like other subarctic streams the Great Bear River contributes from its own banks a small amount of driftwood during the spring break-up, as a result of the destructive grinding and uprooting power of the great volume of moving ice which is brought to bear locally on the river bank forests by ice jams. Immediately above Mt. Charles[3] on the northern bank of the Great Bear is an area large enough for the maneuvering of an army which ice action keeps permanently free of forest growth. It is the result of rather special conditions. The channel is here relatively narrow and the water swift. Ice forms to a great depth on and near the banks because the river repeatedly breaks through and overflows the ice-covered surface. The end of winter finds a great ice dam more than 30 feet thick built across the river just above Mt. Charles, a circumstance which makes the formation of an ice jam at this point an annual event. In 1919 as late as July 30 ice ramparts 20 to 30 feet thick were found bordering Great Bear River above Mt. Charles for more than a mile. These consisted not of the cemented blocks of jam ice but of ice which had formed in place—the ends of a great winter ice dam.

The Principal Source of Mackenzie Driftwood

The Gravel, the Peele, and other large western tributaries of the Mackenzie doubtless carry notable quantities of driftwood into the main stream, but the great bulk comes from the Liard River. The timber growing on the banks of the Liard and its southern branches is about as large as that found on the Peace and Slave Rivers, and its driftwood includes many trees from one to two feet in diameter. The unusually high stage which the Liard reached in 1919 set afloat a vast quantity of stranded logs, many of which

[2] E. M. Kindle: Notes on Sedimentation in the Mackenzie River Basin, *Journ. of Geol.*, Vol. 26, 1918, pp. 341–360.

[3] Deep glacial ice grooves were observed in the limestone trending east and west on one of the highest points on Mt. Charles at an elevation of about 1,400 feet above the river.

had started their northern journey in previous years. At the time the mouth of the Liard was passed on July 1, it was discharging very little driftwood. The vanguard of the main volume of the Liard driftwood reached Old Fort Good Hope on the lower Mackenzie about July 13. At that time the writer was using a canoe a short distance above the old fort and had an opportunity to get a clear conception of the great volume of the floating mass of trees, logs, limbs, and bark. The immense volume of this floating mass of travel-scarred tree trunks and forest débris greatly exceeded anything previously seen or imagined. In general it formed a nearly continuous mass a quarter of a mile or more in width. When, as frequently happened, the mass of drift spread out under the influence of a breeze or current which carried it toward the middle of the river the width often exceeded a mile. Walking over this driftwood was often more feasible than canoeing through it. The closely packed phase of this particular exodus occupied about four days in passing a given point. Detached masses of small size and single, widely scattered logs followed it for several days. Spruce and poplar comprise the great bulk of the Mackenzie driftwood. Here indeed is a mammoth supply of pulp-wood delivered at tidewater, cutting and transportation free, that merits the consideration of any enterprising paper company which can solve the commercial problem of transportation around the Alaskan coast!

This vast contribution of driftwood eventually comes to rest chiefly on the coast of Arctic America and the islands west of Greenland. Frank Russell, traveling down the Mackenzie delta and along the coast to Herschel Island, remarked the immense quantities of driftwood brought down by the Mackenzie "strewn for hundreds of miles along the coast. . . The sand beaches of the coast are literally covered with the white trunks from which the bark and branches have been worn."[4]

Other travelers have noted the large quantities of driftwood seen along the Arctic coast east of the Mackenzie, which is evidently its principal source. Dr. R. M. Anderson has informed the writer that he found it much more abundant on the western than on the eastern sides of projecting points along the shore east of the Mackenzie. On the coasts of Victoria Island and Banks Land seen by Dr. Anderson, driftwood was scarce as compared with the mainland.[5] That it is distributed far and wide throughout the Arctic Archipelago, though less abundantly than on the mainland, there can be little doubt.

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[4] Frank Russell: Explorations in the Far North, State Univ. of Iowa, [Iowa City], 1898, p. 142.

[5] Compare also R. M. Anderson (Recent Explorations on the Canadian Arctic Coast, *Geogr. Rev.*, Vol. 4, 1917, pp. 241–266): "At Collinson Point . . . driftwood fuel was abundant, as it is in most places on the coast for two or three hundred miles on either side of the Mackenzie River delta."

THE EVOLUTION AND DISTRIBUTION OF RACE, CULTURE, AND LANGUAGE

By Griffith Taylor
University of Sydney

[With separate maps, Pl. I, facing p. 116]

Introduction

In a recent paper[1] I attempted to show that the chief ethnological characters of man developed largely as a result of marked changes in climate during the Pleistocene age. I showed that the various races are distributed in zones about Central Asia. The most primitive races, the *original* Negritos, occupy or occupied the most distant or least attractive portions of the outer zone. Next come the Negro; and then is a zone including the Dravidian races, the aborigines of Australia, and probably the Botocudo of Brazil. Within in succession follow the Iberian, Aryan, and early Mongolian zones, even more fully represented in the New World than in the Old. Lastly are the late Mongolian peoples occupying the highlands of Tibet and the northwest of China.

It is the purpose of the present paper to show how these migrations from Central Asia occurred and to correlate with them the evolution of the culture of the folk composing them. The order of discussion is as follows:

1. The value of the cephalic index as a test of evolution. Upon this factor my zones are primarily based. I also make some suggestions which may help to explain the changes in color which have vexed ethnologists in all schemes of classification using this factor.

2. The changes in elevation and in coast line which have masked the old "corridors" used by man in his migrations. The position of the deserts has also varied considerably during the Pleistocene.

3. A series of maps which illustrate what I believe to be the stages in the populating of the world by the hundreds of diverse races recognized by the ethnologist.

4. The cultures of the varied people in each zone. It is shown that they agree in many important culture details—no matter how far they may be separated from each other.

5. The factors controlling the growth of a high civilization. It is shown that environment is a more important determinant than heredity. As the

[1] Griffith Taylor: Climatic Cycles and Evolution, *Geogr. Rev.*, Vol. 8, 1919, pp. 289–328. A full summary of this appeared in the *Melbourne Herald* dated August 26, 1919.

environment changes so does the civilization wax and wane, and so different races rise to eminence and then sink into oblivion.

6. Language, perhaps the most important single aspect of culture and the hardest to correlate. I hope to show, however, that each zone has its own common linguistic features, a recognition of which would be of great service to the philologist.

7. In an appendix the suggestions as to the causes of the controlling climatic cycles, which I made in my earlier paper, are modified in some degree, in accord with the research of G. H. Darwin and others.

Part I

The Cephalic Index and Other Criteria

There is a natural belief among most races that one's own people ranks highest of all nations. The Papuan despises the Negrito, the Taniel looks down on the Veddah, the Masai on the Bantu farmer, the "Dago" scorns the Semitic Arab. The Chinese with a culture dating back to 10,000 B. C., the Yucatan Mayas with an elaborate civilization in some respects higher than that of the British Isles at the same time, the Javanese and Cambodians are all dismissed as inferior races without any obvious ethnological reason save that they have not progressed so rapidly in the last 800 years as the white races of Europe. Since man has taken probably one million years to rise from an apelike ancestor, such a small space of time (equivalent to one day in three years) can have no bearing on race variation.

Of all the coefficients which have been used to classify man, the measurement of the shape of the cranium is still in my opinion the best *single* standard. Moreover, it is still one of the most generally determined and so offers greater facilities for comparison than any other. The most admirable demonstration of the value of the cephalic index in the study of the broader problems of anthropology has been made by Ripley in his masterly "Races of Europe."

In August, 1919, I published a chart based on the cephalic index (breadth expressed as a percentage of length) which led me to infer that the yellow type of man had developed from the Aryan type. My belief that the roundheaded cranium (Mongolian) is the later and higher type is corroborated by the results of many investigators, of whom Macalister and Venn may be cited.

Professor A. Macalister (1897) states that "the infantile and primitive skull is relatively long, and that there is a gradual change, phylogenetic (racial) as well as ontogentic (individual), towards brachycephaly."[2] Up to a certain limit this is certainly correlated with, and is apparently produced by, cerebral activity and growth. In the process of development in the individual and the race the frontal lobes of the brain grow more

[2] Quoted in A. H. Keane: Man Past and Present, rev. edit., Cambridge, 1920, p. 511.

rapidly and tend to fill out and broaden the skull. Professor Thompson has shown the same effect graphically by his model of the skull.[3]

Dr. Venn gives figures for Cambridge undergraduates showing that from 19 years to 23 years their cephalic indices increase from 77.9 to 79.2.[4] Later on the frontal bones thicken, and this ontogenetic change is masked. Other writers, however, do not believe that this change to brachycephalism is uniform through life. As the various portions of the brain have very different functions and develop independently, we cannot expect simple or exact correlations. To some ethnologists the undoubted merging of races is a stumbling block. But the merging of colors in the solar spectrum does not invalidate the main phenomenon, i.e. the sequence of colors which is always constant.

In many features the Mongolian is at least on the same level as the white race. The Mongols of Central Asia and of the American Cordillera share with the Alpine (early Mongol) folk of central Europe the honor of possessing the highest cephalic index. They are of course furthest removed from the Negro and Negrito in this important respect. The same order obtains as regards orbital and aural indices and in the cross section of the hair. As regards cranial capacity the white and yellow races are ranked together by Duckworth, though Clapham states that the average weight of the Chinese brain is greater.[5]

Probably when sufficient data are collected we shall find that the evolution of man is epitomized in the children of the races. The recapitulary theory would demand that the Mongol *child* should show criteria somewhat resembling those of the white *adult*. The white child again is more dolichocephalic than the adult and so resembles the Negro. The black child in some respects approximates to the apes.

Color

The control of the color of the skin by climate seems at first sight hardly warranted when we have such anomalies as the fair peoples of northern India and the dark Tasmanians and dark Eskimos in cold regions. But, if we take into account the migration belts and more particularly the *average* climate during the whole evolution of a race, the problem becomes less complex. Let us tabulate the main races with reference to head form, color, and temperature of the region now occupied.

The intensely black races are all dwellers in hot countries and are all very dolichocephalic. They all belong to the three earliest migration zones, i.e. Negrito, Negro, and Hamitic. With this class we may place the lower Melanesians, though they may contain some Aryan blood.

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[3] Quoted by W. L. H. Duckworth: Morphology and Anthropology, London, 1904, p. 262.

[4] John Venn: Cambridge Anthropometry, *Journ. Anthropol. Inst.*, Vol. 18, 1889, pp. 140–154; reference on p. 152.

[5] Crochley Clapham: On the Brainweights of Some Chinese and Pelew Islanders, *Journ. Anthropol. Inst.*, Vol. 7, 1878, pp. 89–94.

In almost every case these dark tribes have lived for untold ages in hot climates. They have never varied their climatic environment since their original development in the hot plains of southern Asia. The Australians

TABLE I—HEAD FORM, COLOR, AND TEMPERATURE
(Average regional temperatures in degrees Fahrenheit)

	COLOR	DOLICHOCEPHALIC	MESATICEPHALIC	BRACHYCEPHALIC
I	Coal Black	Guinea Blacks (78°)	Bishari (80°)	
	Sooty Black	Papuan (80°) Solomon Islanders (80°)	Dravidians (78°) Melanesians (80°)	
	Chocolate Brown	Australian (75°)	Some Hindus (78°)	
II	Copper Red	Niam-Niam (78°)	Algonquian (60°) Maropa (Bolivia) (60°)	
	Yellow Brown	Eskimo (20°)	Guarani (75°) Samoyede (20°) Malay (80°) Plateau Indians, U.S.A. (50°) Tehuelche (50°)	
	Olive Yellow		Polynesian (70°)	
III	Olive White		Italian and Levant (60°) Semites (70°) Japanese (50°)	
	Pale Florid		Western European (50°) Scandinavian (40°)	Alpine (50°) Finn (40°)
IV	Clear Yellow		Hottentot (60°) Brazilian Indians? (75°)	Chinese (50°) N. W. Amerind (40°)

The color data are chiefly from Paul Topinard: Anthropology, London, 1890, p. 344; and from W. L. H. Duckworth: Morphology and Anthropology, London, 1904, p. 353.

have always been much more numerous in the tropical portions of the continent. The Tasmanians have probably been in Tasmania for a few thousand years only, whereas they spent half a million years in the tropics.

There is a strong reddish tinge in the primitive negro skin which is very evident in the infant stage. This persists in some cases—as in the Niam-

Niam of central Africa. Is it not possible that the coppery color of the eastern Algonquian tribes is the same primitive color? The latter belong to the same Hamitic group as the southern Hindu—and have perhaps not yet had the color bleached out of them by their long sojourn in cool countries. The Maropa Indians of the Bolivian lowlands may owe their copper color to a similar cause.

In Group II the dark yellow or yellow-brown folk are all mesaticephalic and, except the Eskimos, dwell in warm countries. The Eskimo is, I believe, an extremely mixed type with a large amount of negroid blood, as his head form shows. Like the Negrito he occupies the least attractive portions of the earth and probably incorporates "débris" from all the ethnological groups. He has been bleached from the original red-brown color to a dirty yellow-brown. The Samoyede is of later (lighter-colored) ancestry; but he has lived for a shorter time in polar regions and so has arrived at about the same color as the Eskimo.

In Group III are the white races. They are of two types. (a) Bleached dolichocephalic brown folk who have moved into the cool damp borderlands of the Eurasian land mass from Africa. They include the Pelasgians in the south of Europe and probably many Nordics in northern Europe. (b) Bleached brachycephalic yellow folk from Central Asia like the Slavs, Finns, and Japanese, who also now live in the cooler moister portions of Eurasia.

In Group IV are the true Mongolians of eastern Asia and of the American Cordillera. They are usually very brachycephalic, showing their late evolution, and have only lately moved out from the desiccated regions of Central Asia. The Hottentots are Iberians (Hamites) who have dwelt in a similar environment. As regards the Brazilian Indians whom Gerland (Berghaus' Physikalischer Atlas) charts as clear yellow, every migration zone is represented in this huge territory—with great color variation as Whiffen shows clearly—and until further anatomical data are obtained it is impossible to classify these races. The reddish-yellow color of certain primitive forest tribes may be the original negro color slightly bleached by their life in the thick shadows. I have no doubt that many dolichocephalic tribes will be found in the depths of the selvas.

Summing up it will be found that the sequence yellow, white-olive-brown, dark brown (black) occurs in every direction around Tibet except perhaps in the little-known Brazilian region of South America. Even here the extinct Charrua of the southeast (Uruguay) were very dark.[6] Thus the color evidence on the whole agrees very well with the migration zones based on anatomical criteria.

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[6]Orestes Aranjo: Historia de los Charrúas, Montevideo, 1911, p. 51.

Part II

Changes in Elevation

The great white civilizations of the day have grown up chiefly on the borders of the Atlantic Ocean. One result of this distribution is that until recently many geologists had perhaps too strong a belief in the permanence of continental morphology. In these regions near the North Sea and near the Alleghanies, though slight changes in the continental shelf have occurred

FIG. 1—The most mobile region of the earth's crust. The chief fault and earthquake belt (mainly after Hobbs) is indicated by ruling: the areas covered by terrigenous deposits (after Murray) by stippling. Much of the region indicated, except about the areas marked *A*, *B*, and *C*, was dry land in early Pleistocene time.

in late geological times, there are no such stupendous bucklings as characterize the coasts of the Pacific or the "Alpine Storm" across the Old World.

In eastern Australia, also, crustal movements have occurred on a somewhat reduced scale, but certainly quite recently in geological time. The canyon of the Barron River in northern Queensland, the intricate network of the coastal drainage, the grand valleys of the Blue Mountains (perhaps the finest dissected monocline in the world), the ten great block faults and graben of the southeast are all of very late Tertiary age. There is little doubt that earth movements are still affecting us here, as elsewhere around the Pacific.[7]

[7] See Griffith Taylor: The Australian Environment (Especially as Controlled by Rainfall), *Commonwealth of Australia Advisory Council of Science and Industry Memoir No. 1*, Melbourne, 1918; *idem*: Physiography of Eastern Australia, *Commonwealth Bur. of Meteorol. Bull. No. 8*, Melbourne, 1911.

The most mobile regions of the crust, those that have suffered the greatest movement in a vertical direction, are within the well-known earthquake belt. Pirrson and Schuchert definitely assign the volcanic outflows of the Pacific, which accompanied these movements, to the Pleistocene.

As a result of much evidence of this kind we must agree that the present age is one of rapid geological evolution. Especially in connection with the old land bridges and corridors connecting the large land masses is this concept of recent marginal change of paramount importance.

For instance, Hedley has shown that the Bass Straits have sunk so recently that much of the marine fauna at each end of the Straits has still not merged.[8] This explains how the Tasmanians crossed over "dry-shod" from the mainland. Hedley is also collecting similar evidence with regard to a continent between the New Hebrides and Queensland. Much greater changes in the seas can be justifiably assumed where greater elevations occurred alongside.

It is highly probable that the Indo-Gangetic plain was a wide strait not far back in the Pleistocene. This would partly explain why the Negro race is absent in India and why the Dravidian race was here preserved so near the cradle of human evolution. In all other directions, where it was unprotected by waters or marshes, this race has been driven forth by higher cultures.

It seems reasonable to assume a large Malayan continent extending from Burma to Borneo. Moreover there is nowhere else in the world so complex a system of rivers as in the Burmo-Chinese marches. Such a physiography is indicative of recent topographic changes.

I have advanced arguments elsewhere showing that the Lake George rift in eastern Australia occurred only a comparatively few thousand years ago.[9] The typical broken drainage lines of eastern Australia with rivers rising on the elevated coast line are reproduced all round the Pacific especially on the American side.

In Alaska we know of a rise of 47 feet as the result of one earthquake. The coastal scarp of California exhibits wave-cut terraces as high as 1,500 feet above sea level. Along the American coast from San Francisco to Chile the traveler has almost constantly in view these giant steps in which the mountains have been uplifted from the sea. In the central Andes Berry has shown that since late Tertiary or Pleistocene times there have been differential vertical movements amounting to a minimum of 13,500 feet.[10]

The terrigenous deposits on the floor of the ocean lend striking confirmation to this hypothesis. It is of course recognized that modern rivers contribute much to these deposits, but wide belts are found in Bering Strait,

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[8] Charles Hedley: The Effect of the Bassian Isthmus Upon the Existing Marine Fauna: A Study in Ancient Geography, *Proc. Linnean Soc. of New South Wales*, Vol. 28, 1903, pp. 876–883; reference on p. 878.

[9] Griffith Taylor: The Lake George Senkungsfeld, *Proc. Linnean Soc. of New South Wales*, Vol. 32, 1907, pp. 325–345.

[10] E. W. Berry: The Age of the Bolivian Andes, *Proc. Natl. Acad. of Sci.*, Vol. 3, 1917, pp. 283–285; see also Isaiah Bowman: The Andes of Southern Peru, New York, 1916.

off Oregon, off the Gulf of California, and again on both sides of Patagonia and Argentina. The coasts of Siberia and especially of China are bordered for 700 miles by a belt of these deposits. The whole of the Malayan Seas is covered with them. They connect New Guinea to the New Hebrides, forming an area which agrees almost exactly with the Papuan ethnological region. Hence there is ground for the belief that the Pacific Ocean was smaller in the Pleistocene period, being reduced by a belt of land varying in width from 100 to 700 miles. Moreover, it is equally important to note that the rugged cordilleras which so handicap communications all round the Pacific were undoubtedly much lower and less dissected—and in all probability less folded—in mid-Pleistocene time.

In conclusion it may be stated that the uniformitarian theory of geological evolution, though true enough through most of the record, applies only in modified form to the Pliocene and Pleistocene epochs, for we are living in one of the most variable and stimulating periods of geological history. This is far from suggesting adherence to the old catastrophic theory, for even today all Nature's processes are processional rather than paroxysmal.

Mountains and Deserts

There are two types of deserts which concern us in the present study: the trade-wind desert, which lies along the tropics; and the rain-shadow desert, which is so striking a feature of Central Asia and to a lesser degree occurs in the western United States and Patagonia.

In my earlier paper I showed that the cooling of the temperate regions which marked the Pleistocene led to an equatorward movement of all the climatic belts, including the trade-wind deserts. There was a compensating improvement in higher latitudes, e.g. in the southern Mediterranean countries, in Persia and Mesopotamia, in Cape Colony, in Utah, and in southern Australia. This condition is now being reversed, and the laterites and other products of aridity formed in the Pleistocene desert lands near the equator are now being disintegrated and removed by the more frequent rains of today.[11] The rain-shadow deserts depend very largely on mountain barriers. This class of desert was of much less extent during the earlier history of man. It has been shown that the Himalayas, the Andes, and Rockies have probably added many cubits to their stature quite recently. Before this growth occurred the arid plains of Tibet were warm grass-covered steppes. The now desolate *punas* of Peru were fitted for human occupation. The Great Basin of the United States was filled with fresh water of which the Salt Lake is a very degenerate descendant.

The conditions in Egypt and northern Africa have deteriorated remarkably since the times of the ancient Pharaohs. It seems likely that the unspeakable Turk is by no means wholly to blame for the misery of the Oriental lands which he has dominated for centuries. The dry features

[11] H. I. Jensen, private note *re* Northern Australia.

here, however, are due to the swing of climatic belts rather than to the growth of mountain barriers.

Part III

Populating the World—the Major Stages

It is thus obvious that the factors controlling the evolution of the human races are complex, but not, I believe, undecipherable. *Heredity* certainly determines race, but largely because man's ethnology has been the result of age-long residence in the Asiatic cradle—where racial characters have slowly been developed. Even here it is the varying *environment* which has very slowly molded the race. But his status and place in the scale of civilization have been largely controlled by his *environment* after he has moved out into the world. Nothing is more striking than the slight factors which have apparently led to such mighty results. The original Fuegian moved to the northeast from Asia; the Goidel moved to the west. Yet one is now almost the most primitive of races; the other partly builds up the sturdy Scotch race playing a major part in the control of the activities of the world. Yet these races are ethnologically akin.

The chief stimulus determining the evolution of man has been the unique variation in the climate of the Asiatic land mass during late Tertiary time.

In my earlier paper I described briefly the reasons for my belief that the Negrito was the earliest form of man, and that he originated somewhere between Persia and Malaya. One important feature of the Negrito migration was the numerical inferiority of the tribes. They were never able to resist the advance of stronger peoples, so that tribes were often almost annihilated and the women distributed among the conquerors. The resulting children would conceivably form a despised race which would tend to join their dwarf fellows in the forests. Some evidence of a primitive dwarf Negrito race is found in all the continents, but nowhere is there a race which has not mixed with the neighboring tribes to some extent. Hence we find, as will be shown later, that the head form is much more varied than in any other of the major races of mankind. Undoubtedly the most primitive Negritos are found in the forests of central Africa and include the Akka and Batwa.

Negrito folk have been doubtfully described from Peru, southern Chile, and Venezuela in America.[12] There is no doubt that Bushmen formerly existed in northern Africa and in western Europe (i.e. some Aurignacian people).

The Folk in the Günz Ice Age

In Figure A, Pl. I, I have attempted to reconstruct the continents during the Günz Age.[13] The date of the change from apes to man is usually placed

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[12] On a possible pygmy race in Central America see S. P. Verner: The San Blas Indians of Panama, *Geogr. Rev.*, Vol. 10, 1920, pp. 23–30.

[13] For a correlation of the stages of Penck and Brückner (Die Alpen im Eiszeitalter, Leipzig, 1909) see F. Leverett: Comparison of North American and European Glacial Deposits, *Zeitschr. für Gletscherkunde*, Vol. 4, 1909–1910, pp. 241–295; 320–342.

in the Pliocene. During the early Pleistocene I imagine that the Negrito type and probably the Neandertal type were both developing. The former probably gave rise to the various pygmy types and the latter perhaps to the Negro type.

We get no certain evidence of man in Europe until the later Ice Ages, but it is logical to assume that the primitive folk had evolved earlier in Asia; since we know that the later sequence of development was continuous in southern Asia.

In Günz times (which are dated at 800,000 B. C. for reasons given in my earlier paper)[14] a large ice sheet covered the high latitudes, approximately as shown. The trade-wind desert belt moved nearer the equator. The Malayan and Persian lowlands were probably covered with forest into which the Negrito folk retreated. It is probable that the Gangetic strait was in existence, so that most of the Negritos moved to the southeast and southwest before the on-coming cold. Their descendants are still most numerous in these two quarters. This separation into two diverse *wings*, occurs throughout the migrations.

The Günz-Mindel Interglacial

During the Günz-Mindel Interglacial the climate of Central Asia greatly improved. For some hundred thousand years the primitive types developed in the forests which has moved north again after the retreating cold. The tribes gradually spread and became accustomed to a cooler climate than that suiting their ancestors. Thus were evolved the true Negro peoples and later the Bantu.

Towards the Close of the Mindel Ice Age

The Negro races moved to the south with the migration of the forests and of the fauna on which they preyed (see Fig. B, Pl. I). They drove the scattered Negritos before them. We find few true Negro people to the east of the center of dispersion, though some tribes of this migration are seen in the frizzy-haired, very dolichocephalic Papuans and Melanesians. Some traces also occur in the negroid Susians of southwestern Persia.[15]

This distribution leads me to suppose that the Deccan was inaccessible and the Malayan continent not so readily reached as the broad lands of Africa. Skulls both of Negritos and Negroes are known from Egypt. Steatopygy and hair on the body are indicated in models from early graves, and this also demonstrates that the Negritos and Bushmen passed through Egypt on their route south. Similar artifacts from southwestern Europe probably date a little later but give us accurate information as to some of the earliest peoples of Europe. The direct path to Europe was blocked by the Ural Gulf, and all our earliest ancestors moved into Europe from the

[14] See also Appendix to this paper.

[15] See W. Z. Ripley: The Races of Europe, New York, 1899.

south. However, the negroid folk for the most part would keep to the forested country, which lay then as now near the equatorial regions.

The Bantu, both in culture and ethnology, come between the Sudanese Negroes and the Hamitic peoples. We have not much evidence as to whether they developed from the Negro tribes who remained in Asia or whether they originated very much later in the park lands of the Sudan on the borders of the Negro tribes. Johnston inclines to the latter belief and thinks that their language shows Pelasgian affinities due to Hamitic traffic across the Sahara.

It may be well to dwell for a moment on the "Hybrid Theory" of race origins, and use the Bantu as an example. One school believes that the Bantu is a cross between the Negro and the Hamite. They do not in general explain how the Negro reached Equatorial Africa nor how the Hamite occupied northern Africa; but, assuming these facts as inexplicable, they state that the Bantu is a merging of the two distinct races. This may be true, but to my mind it is more logical to assume that the stimuli which changed the ape man into the Negro continued to act and produced the Bantu and continued further and produced the Hamite. The results as regards distribution and as regards anatomy, culture, and language are not very different. Probably we shall never be able to say definitely where primitive "Asiatic" differentiation ceased to operate and the hybridization of adjacent tribes in their ultimate settlements began. Modern statistical methods combined with the graphic representation of racial characters will, however, go far towards the desired result. In the particular problem cited we may obtain evidence from the language and customs of the Susians. Are they primitive negroid or do they show Bantu affinities?

During the Mindel-Riss Interglacial

The climatic and competitive stimuli remained strongest in the center of the great Asiatic land mass. The cephalic index of the folk who fought the changing environment increased during this period from about 72 to 74 (see Fig. C, Pl. I). Thus was evolved the Mousterian. His most natural route for migration was obviously to the south and east, for we may assume that the Gangetic plain now rose out of the sea, and that the partial barrier to the Malay region (which may have been open water, very high mountains, or possibly unusually thick tropical jungles) was now removed. Many Mousterians moved to the west across the Red Sea into Africa, where they perhaps encountered the Bantu folk. At any rate we know they moved northwest along the Mediterranean coasts and entered Spain and France. Their skulls occur plentifully in these countries, typically at Moustier. Other hordes migrated into the Deccan pushing before them a few Negritos, who ultimately found refuge in the islands off India (Veddah in part, Andamanese, etc.).

It seems probable that nowhere was there any large population. All these

tribes lived by hunting, and it would be logical for them to be on the whole moving onward, so as to keep plenty of room between themselves and any succeeding tribes. They had all the world before them, and I doubt if any district became at all thickly populated till long after the last Ice Age.

The Riss-Würm Interglacial

The Riss Ice Sheet advanced from northern centers about 400,000 B. C. and its associated marginal climatic conditions drove most of these folk away from the cradle of the race. On its retreat there ensued the long years of the next Interglacial period (see Fig. D, Pl. I). In southern Asia developed the Iberian race, which gradually expanded and drove the Mousterians away on all sides. Man had become accustomed to a cooler climate, so that we find the Mousterians fleeing to the northeast and ultimately reaching America *via* the Bering Corridor. I am, however, disposed to fix their entry into the unoccupied continent about the time of the last (Würm) Ice Age, about 100,000 years ago.

During this Interglacial period Mousterian man occupied western Europe and the Malayan region. The latter was much larger than it is today; but, since no true mammals ever reached Australia, it seems likely that there was always a wide break somewhere between Java and New Guinea.

Bean has shown that the aboriginal folk all through the Philippines belong to this Mousterian (Australoid) migration,[16] possibly mixed with the Negrito.

The Würm Ice Age

As the last ice sheet advanced it drove forth the Aurignacian and Iberian peoples (see Fig. E, Pl. I). They spread fairly uniformly to the west, south, and east. They occupied the warm park lands especially in central India and around the Mediterranean. Large tribes must have moved to the northeast with the retreat of the Würm Ice Sheet, so that possibly there were more Iberians (including the earlier Aurignacians) in Manchuria and the vicinity than anywhere else.

At this date we may picture the scattered Mousterians spreading through North America and through Malaya into northern Australia. Probably they marched along the New Guinea tract, which was undoubtedly much broader and lower at this time. The trade-wind desert now occupied most of northern Australia. Probably New Caledonia was nearly joined to New Guinea, for the early Melanesian folk reached the former place presumably before navigation was of a high order. In a later section I discuss the possibility of some low-statured peoples (Aurignacians) forming part of this migration.

The Azilian Age

This was pre-eminently the age of great migrations (see Fig. F, Pl. I). The climate was becoming much warmer, and towards the close of this age

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[16] R. B. Bean: The Racial Anatomy of the Philippine Islanders, Philadelphia and London, 1910, p. 233.

(about 40,000 B. C.) there is no doubt that in general it was warmer than at present in temperate regions. The great feature of this period was the broad corridor extending from Siberia to North America. It was quite free from ice, and the southern border in summer was no doubt a pleasant land resembling Scotland. The absence of the Polar current which now chills eastern Siberia would also greatly contribute to this result.

Meanwhile the Aryan and Mongolian peoples were arising in Central Asia and spreading forth, pushing the Iberians ever outward. It is certain that the interior of Asia altered completely in character during early Neolithic times. The great mountains rising to the south gave an excessive rainfall to northeastern India but deprived the Tarim Basin and Tibet of the most vital factor in civilization.

Hence we find a resistless pressure outward on the part of all the folk of Asia. The greatest migrations occurred to the northeast, where the resistance was least. For, as the first Iberians reached America, they would find a glorious country improving in climate and food supply the farther they moved to the south. One can picture a "stampede" of peoples such as the world had never seen before and can never see again. Only a few helpless Mousterians would flit through the woods ahead of them.

Movements in America

The woodlands would offer a much more tempting corridor and a better food supply than the open prairies to the east. Hence we may picture the Iberians moving almost due south at any rate as far as Mexico before they curved round to the east.

It seems probable that the topography of Central America was very different in Azilian times. As Huntington has shown, the climate was better than it is now even within historic times. Probably the migration zones themselves offer the best argument in support of an easy land route between the two continents. We find a parallel distribution of peoples. In both the northern and southern continent the broad "main" corridor lay along the open uplands of the west, while the more primitive tribes were pressed to the east away from the main route.

The Iberians in Europe and Africa

The Iberians occupied Egypt and almost the whole of Europe. They were a people with much architectural skill, the builders of the megalithic monuments. These monuments are found almost all over the world save where the lower races have held their ground. Thus we get them not only where Iberian folk still remain but also throughout central and eastern Asia and through Russia, where there are no Iberian peoples today. This fact seems to me to prove conclusively that the Megalithic folk were by no means a coast-loving people, moving eastward from North Africa to Poly-

nesia and America, as Elliott Smith suggests, but were one of the major migrations that spread *centrifugally* from Central Asia in all directions.

In Africa they followed the main corridor down the open park lands of the east; and their forerunners, the Hottentots, ultimately reached the extreme south. Here they were isolated by the huge numbers of Bantu who pressed across their track (from the northwest) at a much later date. The Hottentot in fact represents very closely what is called an "outlier" in geological language.

Place of the Semites

The Semites were probably the highest development of the Ibero-Hamitic migrations, rather than the lowest of the Aryan peoples. The merging of the Libyan Hamites into the Semites, and the much greater differences between Semitic and Aryan languages corroborate this. Moreover, in Melanesia we seem to get a closer relation between the Iberian and Semitic zones than with the later tribes of New Britain who are early Aryan, I believe (see also the lava-flow analogy, Fig. 9).

The Semites and Iberians are closely linked, the former being a late variety with many striking customs which they have carried all over the world. Hence has arisen the myth of the Lost Ten Tribes. The Jews proper are a small tribe who migrated from Palestine within the last two or three thousand years; but the allied Semitic migration reached America about 50,000 years ago, while various isolated tribes of the same type were probably first planted in portions of eastern Asia nearly 100,000 years ago. I shall deal with the evidence linking these pre-Aryan (Semitic) folk together in a later section.

Later the Aryan peoples also poured into America during early Neolithic times. Ethnology has not only developed very recently but also only among the white folk of western Europe, so that they naturally called their own kin the "Indo-Aryans." But 2,000 years ago an impartial ethnologist would probably have termed the western Europeans an unimportant offshoot of the great family of olive-white peoples with an index near 78, which moreover he might reasonably have named the "Indo-Amerind" family.

Early Alpine Folk in Europe

It seems probable that the first Asiatics in Europe were Alpine folk who had short heads (83–85) and who moved along the central highlands towards the close of the Azilian period. They brought in a new culture not necessarily equal to that of the African longheads. As I explain later, it seems to me almost certain that they spoke a primitive Aryan tongue allied to the Galcha of the Pamirs. We find these folk in the mountain regions of France and Switzerland as the Cevenole and Ladin peoples. I expect that a similar primitive structure and vocabulary will be found to ally the Ladin, Romansh, Illyrian, Ossete, Armenian, and Galcha languages; but I can find little data on the subject (see below).

A few of these early Alpine folk reached Britain, where they built the round barrows. But this was much later (in the Bronze Age), and they made no permanent impression on our dolichocephalic race.

Prehistoric Age and Later

The chief stimulus to change and migration of late years has been the desiccation of Central Asia. This is shown by the researches of Sven Hedin, Huntington, Sir Aurel Stein, and in fact by all who have traveled in Tibet, Mongolia, Turkestan, and Persia.

Many thousand years before Christ the Chinese started to move down from the Tarim Basin through the "Jade Gate" to cccupy the upper basin of the Hwang Ho. To my mind they represent perhaps the latest development of the human race. The conquering Chinese of this early period were much more brachycephalic than the mixed race which now occupies the south and east of China. It is, however, this latter class which is best known to the foreigner, and they have usually been taken as of pure Chinese blood. But the invaders (with an index around 87) found China in the hands of Aryan and Iberian races, of whom many still survive in southern China. Some of these are the Miao-tse, Lolo, Hakka, Yao, Li, and Minchia tribes.

The Chinese set in motion the Tungus and allied people, who again found in the great corridor via the Bering region the line of least resistance. Probably other tribes had preceded them all through Neolithic times. These Mongolian hordes with cephalic indices from 83 to 88 moved along the western plateau of North America right down into Patagonia, where they are typically represented.

They have indeed made but two important incursions from the main corridor. The first is the great Shoshone-Muskogean migration which has taken brachycephalic Amerinds to Florida and to Lake Michigan. The second is the Carib incursion along the northern coast of South America.

Although the brachycephalics (83–88) are fairly uniformly distributed along the plateaus, there is strong evidence of surges from earlier peoples across their main path. Thus the Salishan peoples are probably of earlier origin (80–82) and occupy British Columbia.

The Shatter Belts

The last migrations have apparently been by far the most violent. They have found the world already occupied by more or less settled tribes, and in consequence a tremendous clashing and breaking up of races has occurred. This is especially marked in those regions for which I suggest the name "Shatter Belts" (Fig. I, Pl.I). The main line of disruption occurs all along the Great Corridor from the Malayan region through China, eastern Siberia, and the western coast of America. Here the débris of primitive tribes is

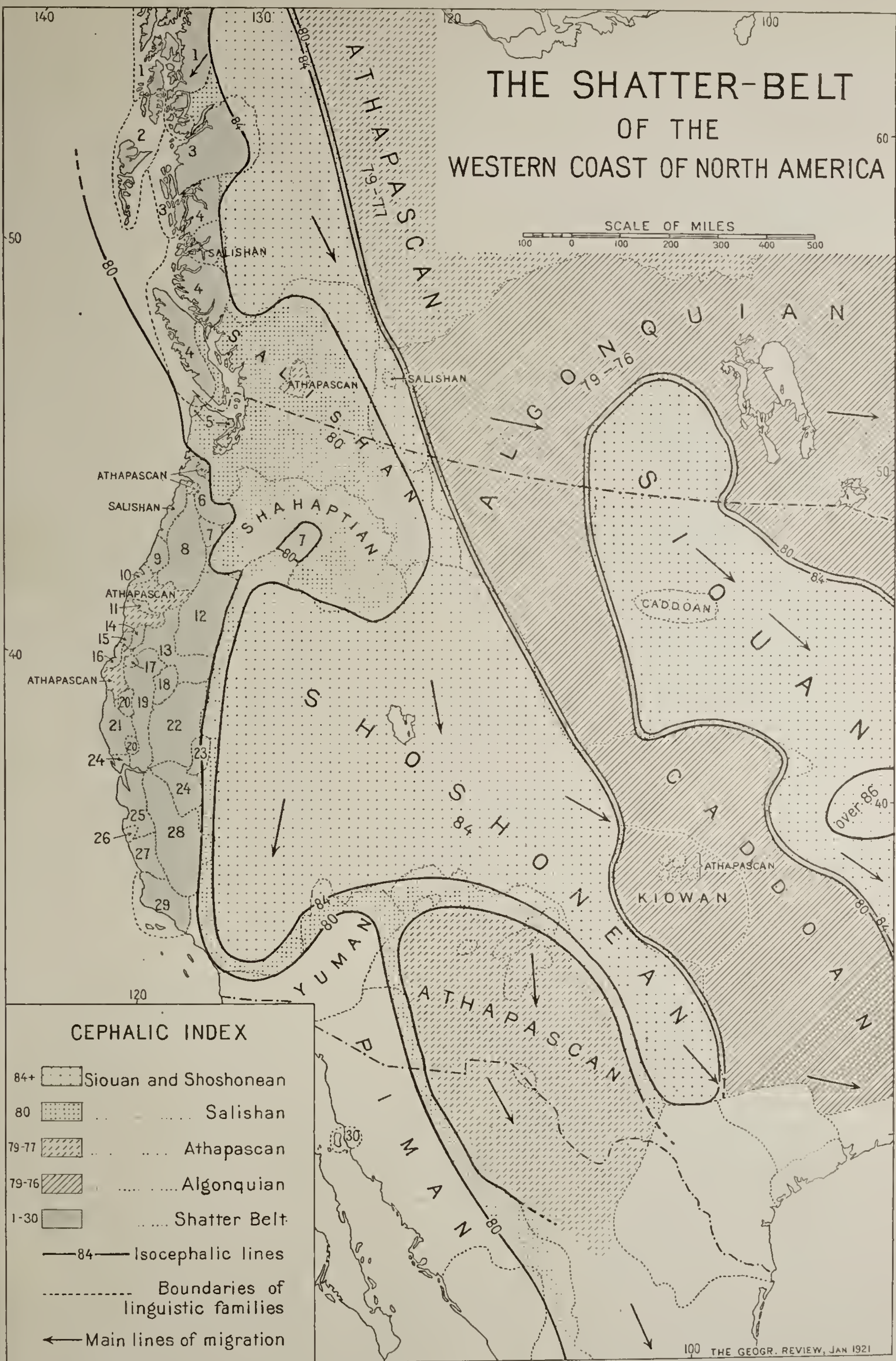

FIG. 2—The "Shatter Belt" of the western coast of North America. Ethnically and linguistically the term "shatter belt" is applied to a region, marginal to main routes of migration, occupied by a "mosaic" of tribes. The tribal distribution shown above is from the map by J. W. Powell (revised) accompanying "Indian Population in the United States and Alaska, 1910," Bureau of the Census, 1915. The linguistic families in the shatter belt are (besides Athapascan and Salishan): (1) Tlingit, (2) Haida, (3) Chimmesyan, (4) Wakashan, (5) Chimakuan, (6) Chinookan, (7) Waiitatpuan, (8) Kalapooian, (9) Yakona, (10) Kusan, (11) Takelma, (12) Klamath, (13) Shastan, (14) Quoratean, (15) Weitspekan, (16) Wishoskan, (17) Chimarikan, (18) Yanan, (19) Wintun, (20) Yukian, (21) Pomo, (22) Maidu, (23) Washoan, (24) Moquelumnan, (25) Costanoan, (26) Esselenian, (27) Salinan, (28) Yokuts, (29) Chumashan, (30) Seri. Notice especially the Athapascan portion of the mosaic separated from the main tribe by the migration of brachycephalic Siouan and Shoshonean along the main corridor.

scattered like scum left by a great wave. Perhaps a closer simile is the line of shattered and altered rocks which marks the course of a great line of disruption in the earth's crust.

We find the mixed races of the Malayan region inextricably tangled. The Ainu and the Paleo-Asiatics occur in northeastern Siberia. Down the coast of British Columbia and California are four times as many distinct tribes as in the rest of North America. The small dolichocephalic tribes of California have been pushed to the west by the stronger brachycephalic folk. The important tribes of Athapascans of New Mexico are longheads, as are also many of the Piman tribes of Mexico (see Fig. 2).

Probably each of these shattered American tribes has a counterpart in the broader territory of the eastern peoples. We know that this is true of the Athapascans of Oregon and of the northern Plains. It is highly probable that the Salishan folk were originally connected with some of the (Sioux?) tribes of Iowa and Dakota. The Seri (76) of the Gulf of California are most marvelously preserved, and the congeners of these Iberian people will probably be found in the extinct Hurons of the far east, or possibly in the Tupi-Guaraní people of South America. Similarly we get Pano (in the Huallaga and Marañon basins) in the north and Yahgan in the south of South America, Bororo in Matto Grosso and Tehuelche in Patagonia as probable disrupted pairs in the southern continent.

In South America there is another shatter belt, where the more primitive tribes are driven down against the impenetrable forests of Brazil from their old highland homes. A crescentic belt of mingled tribes is shown by Chamberlain[17] in his ethnological map of South America. It starts in Colombia between the Chibcha and Carib regions. It continues southward between the Aymará and Arawak (forest) tribes. It curves round to the east about the Tapuyan tribes of eastern Brazil.

In the Old World the finest example is perhaps in the Caucasus, where Ripley shows a whole series of peoples f.om the longhead Kurds (77) and Tates, through the Alpine Abkhasians (probably from the Altai Mountains) and Ossetes (81–82; from the Pamirs center) to the Armenians (85; from the Pamirs) and Mongol Tatars (from the Altai center). Another such belt occurs along the margin of the Abyssinian Highlands where Sudanese, Bantu, Hamitic and Semitic tribes clash together.

Later Aryan and Mongolian Migrations

The great Polynesian migration occurred probably as a result of the Chinese thrust from Central Asia. Linguistic and ethnological data link the Polynesians with the Koreans, Japanese, Formosans, Indonesians, and Javanese. Legends and genealogies show that about the dawn of our era the early Polynesians were among the Malay islands. By 450 A. D. they

[17] A. F. Chamberlain: Linguistic Stocks of South American Indians, with Distribution-Map, *Amer. Anthropologist*, Vol. 15 (N. S.), 1913, pp. 236–247.

had reached Samoa and by 850 A. D. Tahiti. Somewhat before this one bold Polynesian had reached Polar ice in his huge war canoe. In 1175 A. D. the primitive Moriori (77) were driven out of New Zealand to the Chatham Isles. No doubt New Zealand was first reached several hundred years before this. Tahiti seems to have been a center of dispersal, as Percy Smith has pointed out in his interesting book "Hawaiki." We must however remember that Melanesians preceded the Polynesians to many of these islands at a much earlier date.

No doubt the early Mongolian folk of China and Japan were equally skillful sailors. It seems possible that some of the tribes migrated to America about the same time. The resemblances between the cultures of the Haida (82) and the Polynesians (80–83) have often been pointed out. Moreover, just as in Europe the Alpine roundheads (83) in part preceded the Teuton longheads (77), so we may perhaps see something of the same sort of anachronism in British Columbia; i.e. that the Salishan "spearhead" penetrated the more brachycephalic surrounding tribes instead of preceding them, as is almost invariably the case (see Fig. 2).

It is only so late as 1200 B. C. that the Aryans first appear in European history. Their exploits are sung in Homer, who describes the wars between the Trojan (dolichocephalic) Pelasgians and the Aryan (brachycephalic) Achaeans. The latter entered Europe by the Ural route.

We may picture the Goidels (76–77) at an even earlier time moving to the northwest perhaps from Africa and ultimately reaching Ireland. Then came the Brythons (77), possibly via the Danube, who also settled in Britain. Both these peoples found Iberian Picts in the country before them. The Itali who came down into Italy from the north were very largely composed of Alpine folk. They merged with the Iberian Etruscans and founded the Roman Empire. Many Aryans (Dorians, Achaeans) invaded Greece and displaced the Iberian (Mycenaean) civilization. The Teutons advanced from southwestern Asia along the northern plains of Europe and sent an offshoot, the Anglo-Saxons (79), into England about 500 A. D.

The migrations of the Keltae were both earlier and later than those described above. The Keltae are an Alpine brachycephalic race (83–88) akin to the Cevenoles and in no sense akin to the dolichocephalic Goidels and Brythons, who are also unfortunately called Kelts. They dispossessed Iberian people in France, central Europe, and probably in the north of Spain. I shall refer to the relation of the Keltae to the Teuton and Romance peoples in a later section.

The Slavs (82) are certainly an Alpine race allied to the Keltae, who invaded Europe (including Germany and Greece) in historic times.

The first true Mongol invasions, those of the Huns, occurred in the fourth century before Christ. The Lapps are also a Mongol race who have long dwelt in northern Europe. The Finns are allied to the Slavs but came from far to the east of the latter. Hence their language is Altaic not Aryan.

Part IV

The Evolution of Culture

This is a phase of science which has been treated very fully in many notable volumes. I propose here merely to discuss its relation to the migration zones already described. There have been many suggestions that similarity of custom implies a common origin; but where the custom alone is considered it has not been hard for opponents to show that the similarity of custom may be due to the common tendency of all races to evolve into higher types. I hope that I shall be able to demonstrate that in most cases these characteristic customs accompany marked anatomical resemblances. This union of such dissimilar criteria must surely point to a common ancestry of the several peoples concerned.

Zone I, Negrito Type

It is very difficult to correlate the Negritos, for two reasons. In the first place they are very shy and have nowhere been adequately investigated. In the second place there seems little doubt, as I have previously remarked, that there are no true Negritos left.

Dr. Birkner believes that there are varying stages of dwarfishness and that the Asiatic Negritos are only partially dwarfed. Some of the pygmies have the limb proportions of children rather than those of adults; and, as Duckworth logically suggests, these would seem to be the most primitive.[18] In the latter case the legs are shorter and the trunk longer than normal, and such features occur in the Uganda Negritos.

There seems no doubt that the Tasmanians were Negrito half-castes with the Dravidian Australians. As Sollas shows, the low cranial vault occurs in 75 per cent of the Tasmanian skulls, in 65 per cent of the South Australian, in 40 per cent of the Victorian, in 26 per cent of those in New South Wales, and in only 3 per cent in the highest Queensland aborigines. The language of the Victorian Kurnai and Narrinyeri is also allied to the Tasmanian. The latter people were collected together in 1835 and only numbered 203. In 1847 there were 48; in 1854, 16; in 1865, four women; and the last (Truganini) died in 1877. There are, however, a number of half-castes (with some white blood) still alive on Flinders Island in Bass Strait.

The Pure Negrito Extinct

There is no doubt that similar racial annihilation has often occurred in the history of man. To my mind this explains why we find no *dwarf negroid with peppercorn hair* (i.e. Negritos) with a lower head index than 73. The stronger Negro stock of Melanesia and of the Guinea Coast have

[18] Duckworth, *op. cit.*, pp. 483 *et seq.*

skulls with indices of 70 or lower. These Negroes are purer races than the Negrito of today but have been evolved later than the original (extinct) Negrito.

The culture of these (half-caste) Negritos is always low but varies with the proportion of foreign blood. The culture of the Tasmanians may be taken as representative of the lowest. They usually went naked but occasionally wore skins. They gashed themselves as a sort of primitive ornamentation. They built nothing so useful as the Australian "wurley," though the Tasmanian climate was much colder (55° F.). They used plain

TABLE II—NEGRITOS AND ALLIED FOLK

	NAME	CEPH. INDEX	CAPACITY (in c.c.)	HAIR	SKIN COLOR
Africa	Bambute	79.2	1,400	Peppercorn	Black
	Akka	74.4	1,100	Peppercorn	Red-Yellow?
	Batwa	74 ?		Peppercorn	Black
	(Bushman)	74.5	1,331	Peppercorn	Yellow
Australasia	Tasmanian	74.0		Frizzy	Chocolate Brown
	Tapiro	79.5		Frizzy	Black
	New Britain Islanders	73.0		Frizzy	Black
Asia	Semang	76.2	1,230	Peppercorn	Chocolate Brown
	(Sakai)			Wavy	Black
	Aeta	79.6	1,419	Peppercorn	Chocolate Brown
	Andamanese	82.1	1,266	Peppercorn	Black
	(Veddah)	71.5		Wavy	Red-Brown

wooden spears and clubs and rough stone scrapers and choppers. They had a rude raft like the Californian balsa, which probably enabled them to cross the narrow seas from Asia to Australia.

In Africa there are many grades of Negrito from the Batwa, Bambute, and Akka up to the Bushman (the last, however, are more properly considered with the Aurignacians or primitive Iberians). Similar variation is found in the southeast of Asia. The Kalangs of Java are now extinct but were extraordinarily simian in appearance. The Andaman Islanders resemble the Tasmanians in their low culture. The Sakai and Semangs of Malay have a considerable amount of Malay blood in their veins, but the latter show extreme prognathism. Many of them, like the Tapiro of Papua, are quite wild and keep aloof from civilization.

The Aeta of the Philippines have a head index of 82 which is much superior to that of most Britishers (78). They are undoubtedly Mongolian-Negrito hybrids. Some of these Negritos are thus brachycephalics, and naturally the higher hybrids are the least shy and therefore the best known.

It seems wrong, however, to say that this primitive human type is normally brachycephalic,[19] for the more primitive Negritos are precisely the more dolichocephalic. They are already known with indices as low as 73 (New Britain) and 74 (Tasmania), and we may yet discover fossil examples of their crania below 69.

Zone II, the Negro Race

There are two well-defined regions occupied by the *lowest* Negro races. In Africa are the Sudanese and West Coast races, in the Australasian region are the Melanesians and Papuans from New Caledonia to New Guinea.

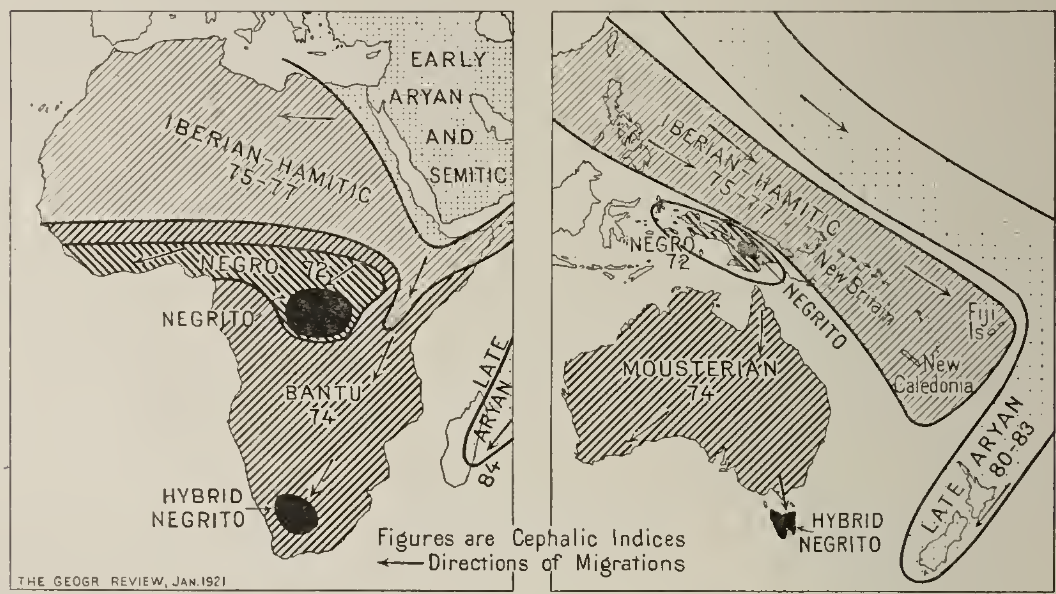

FIG. 3—Maps showing the distribution of races in Africa and Australasia (generalized). The parallelism suggests that the center of dispersion lies symmetrically between them, i.e. in Central Asia.

These resemble each other very closely in physical characteristics, as the following table shows.[20]

It is necessary to remember, however, that the Melanesian region, small as it is, is occupied by the representatives of many major races (see Figs. 3 and 10).

If the separation of the two lowest Negro types occurred in the Mindel Ice Age or thereabouts—as I postulate earlier—there is not much likelihood of any great resemblance in the customs of the two folks. Almost everything characteristic must have developed since that date, except the anatomical features mentioned previously. But in the drum language and in the totem and brotherhood institutions we have undoubted similarities between the *lower* Melanesians and the West African blacks. The primitive (i.e. complicated) nature of the structure of the languages is common to both; but, in view of the little knowledge which we possess on these points, one cannot stress this analogy.

[19] A. H. Keane: Ethnology, Cambridge, 1895, p. 243.
[20] After De Quatrefages from Keane's "Ethnology," p. 264.

A more interesting and suggestive parallel is shown by the geographical distribution of all the races in these two contrasted regions (see Fig. 3). Typical Aryans (77–80) are rare in both.

The true Papuans and western Melanesians (who also speak Papuan), with a head index about 72, have all the character of the lowest Negroes.

TABLE III—PARALLELS BETWEEN THE AFRICAN AND AUSTRALASIAN NEGROES

	Cephalic Index	Cranial Capacity	Facial Index	Hair	Skin Color
Central Africans	71.2	1,424 c.c.	70	Woolly	Chocolate to sooty
Melanesians	70.4	1,412 c.c.	69	Woolly	Chocolate to sooty

They are very excitable, voluble, and laughter-loving and even more cruel than the African Negro. In both cases it seems possible that early closure of the sutures of the skull prevents the growth of the brain. The Papuans of Astrolabe Bay could not kindle an extinguished fire and often ate their food raw. Cannibalism is still rife in the interior of Papua. They have the most primitive social institutions, and even totemic systems are undeveloped

TABLE IV—RACE PARALLELS IN AFRICA AND AUSTRALASIA *

Cephalic Index	Race	Environment	Africa	Malay-Australasia
?	Negrito (a) (b)	Forests Cooler lands in extreme south	Batwa, etc. (Bushmen?)	Tapiro, Aeta, Kalangs Tasmanians
71	Lower Negro	Equatorial forests and park lands	Peoples of Guinea and Upper Nile	New Guinea Southern Melanesia
73	Higher Negro	Cooler park lands	Bantu	Australian
75 to 77	Hamitic and Semitic	Curving around to east of Negroes and equatorial forests	Ethiopians Masai Hottentot	Igorots and Micronesian Higher Melanesians Solomon Islanders
80 to 85	Aryan and later seafarers	Islands to east	Hova of Madagascar	Polynesians

* The Melanesians can be divided into four main groups. The most primitive (71–73) live in the south in Fiji, the New Hebrides, and New Caledonia. The next group (73–75) occupies the eastern end of Papua and the Dentrecasteaux Isles. The cephalic index of the Solomon Islanders is variable round 77; and that of the Papuan coast peoples from Hall Sound to South Cape is around 79. Allied to the latter are the Bismarck group.

for the most part. There is a tendency, however, to accept some animal, e.g. a crocodile, as a "god." In the Loyalty Isles their gods are mostly evil and (as among some of the Bantu folk) harrow the whole life of the tribesman.

In Africa, owing to his proximity to the Hamitic tribes and especially as a result of Moslem proselytizers, the Negro has developed a relatively high culture. But where this stimulus is absent he is much the same as his long-lost brother the Papuan of New Guinea.

The Bantu have no close homologue in Australasia. The Australian has much the same cephalic index (74), but the hair is curly and not woolly like that of the Bantu. No doubt the African is the more primitive biologically, but there is no comparison in the cultures of the two peoples. Nothing is so dangerous to a people as complete isolation. The natural barrier which preserved the Australian aboriginals from invasion also resulted in their remaining in the same low state of civilization for 100,000 years. At the first approach of a more progressive race they have almost vanished from the face of the earth.

There is a fairly close connection between the West Coast Negroes and the Bantu. The Wolof of Guinea and the Bantu language are somewhat akin.[21] Mandingo and Bechuana have similar totems. The Bantu religion is ancestor worship in the east and spirit worship in the west. Throughout, however, there is a strong belief in witchcraft and in gross superstitions.[22]

Zone III, the Mousterian Races

The most primitive examples of this zone are found in the Australian aboriginal. Though the latter is remarkably homogeneous, yet there are three major groups. The Victorian and South Australian coast blacks seem to have been the most primitive as stated previously. For instance they have no class organization.

The tribes of inland Queensland, inland New South Wales, and South Australia have maternal descent, and few of them use the womerah (spear-thrower). The tribes of the northern coasts and of the whole western plateau, as well as those of the New South Wales coast, have paternal descent and use womerahs. It is very difficult to decide which of the two latter groups is the earlier. Graebner links the womerah-users and clans using paternal descent with the West Papuans; and the maternal clans with the less primitive northeastern Melanesians.[23] Usually paternal descent, implying that the father of the child is known, is the latest development (see Fig. 4).

As regards means of navigation, there is a natural progression from southwest to northeast. From Shark Bay to Adelaide there are no boats.

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[21] H. H. Johnston: Note on a paper by E. H. L. Schwarz on "The Origin of the Hereros and Ovambo," *Geogr. Journ.*, Vol. 54, 1919, pp. 49–52.

[22] A. H. Keane: Man Past and Present, rev. edit., Cambridge, 1920, p. 85.

[23] Graebner: Anthropologie, 1913

Along the northwestern coast are rafts only (as also near Burketown, Q.). In the next zone is the bent-bark canoe of Victoria. Then comes the sewn-bark canoe of Wyndham (W. A.), the Gulf of Carpentaria, and the East Queensland coast. Lastly are the wooden canoes of Darwin and the outrigger canoe of Cape York Peninsula.

The totem in Australia (see Fig. 5a) usually represents an animal, from which the tribe is believed to be descended. The name passes to the next generation either by paternal or maternal descent. The totems are often

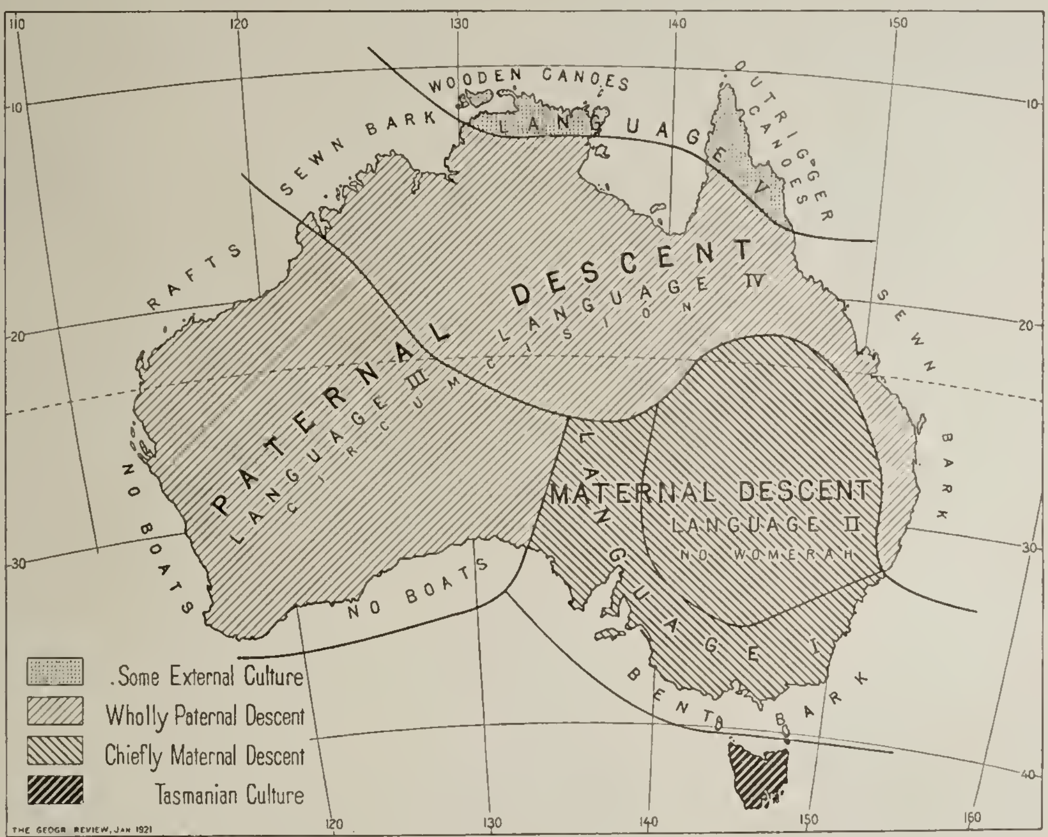

FIG. 4—The chief culture zones in Australia. Social grouping (descent), language, navigation, etc., are the bases of classification (after Sollas, Curr, and Graebner).

arranged in two classes which specifically control the exogamous marriages. Initiation is marked by bull-roarer music, and usually includes knocking out teeth or (in the paternal-descent region) circumcision. Fire ordeals, i.e. kneeling on burning fagots, etc., are common. Belief in magic is universal, while the wizard is credited with being able to suck out illnesses and remove "poison sticks." This latter custom is found in almost all primitive cultures.

After a death the widow besmears her head with pipe clay and wears a chaplet of bones. This is buried in the grave a year later. The Arunta used crouch burial, and other central natives use platform or tree burial. Later the bones are collected. In Melville Island (N. T.) twelve carved grave posts are placed round the grave. It is obvious that many of these primitive customs are found in every continent, which is what one would expect. The important point to notice is that these aborigines have evolved

a complex system of totems and customs which cannot have been borrowed since they reached Australia. Thus father and mother descent both occur in this very primitive group, and so do many burial customs; so that these cannot be used *alone* to differentiate the other races of the world.

Distribution of the Bull-Roarer

The bull-roarer, as Haddon shows,[24] has survived throughout Europe as a toy, but in connection with sacred mysteries it was used in ancient Greece, on the West African coast, among the Kaffir, throughout North America (among the Eskimos, Kwakiutl of British Columbia, Apache, Hopi, Navajo), and in the Solomon Isles and New Guinea. In fact he calls it the most ancient and widely spread religious symbol in the world. Circumcision also is in vogue from these low peoples in the northwestern half of Australia up through tribes of Loango, the Copts, the Persians, the Aztecs, and Caribs.

Totemism

Totemism is almost equally widespread. The chief regions are Australia, Melanesia, central and western Africa, and North America. There are also relics of totemism among the Dravidian hill tribes, as we should expect from their similar ethnology (see Fig. 5a).

Totemism occurs only among the lower tribes with indices from 72 to 78. It varies in character in the different regions. In Australia when grubs are scarce the tribe gets a man with the grub totem to propitiate his totem by stroking its stone representative. Sooner or later this results in an abundance of the delicacy!

There is a tremendous ethnological and geographical gap between the Australian aborigines (74) and the Amerinds (74–78) of the eastern United States, where totemism is also very strikingly represented. But we should remember that America is now isolated from the Dravidian peoples by a whole continent of Mongolian peoples of high cephalic index. No doubt the Iroquois (74) and Algonquians (76) carried their totem customs with them from Asia, where they are still found in southern India. Probably intermediate tribes using totems are recorded around the fringe of the Mongolians.

Although some totem tribes in America believe that the totem group is under the tutelage of the guardian spirit, yet exogamy, taboo, and class names exist where there is no cult of the guardian totem. The clan totem descends, but the personal totem is acquired by the youth going off to a favorable locus to dream of his desired totem. The Tlingit, Haida, and Tsimshian tribes (79–83) have animal totems, but they do not believe that they are descended from them.[25] Evidently here they are merely clan badges.

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[24] A. C. Haddon: The Study of Man, London, 1908, pp. 277–327.

[25] Handbook of the American Indians, *Bur. of Amer. Ethnology Bull. 30*, Washington, D. C., 1907–1910, article "Totem."

MAPS SHOWING THE CORRELATION OF CUSTOMS WITH CEPHALIC INDEX

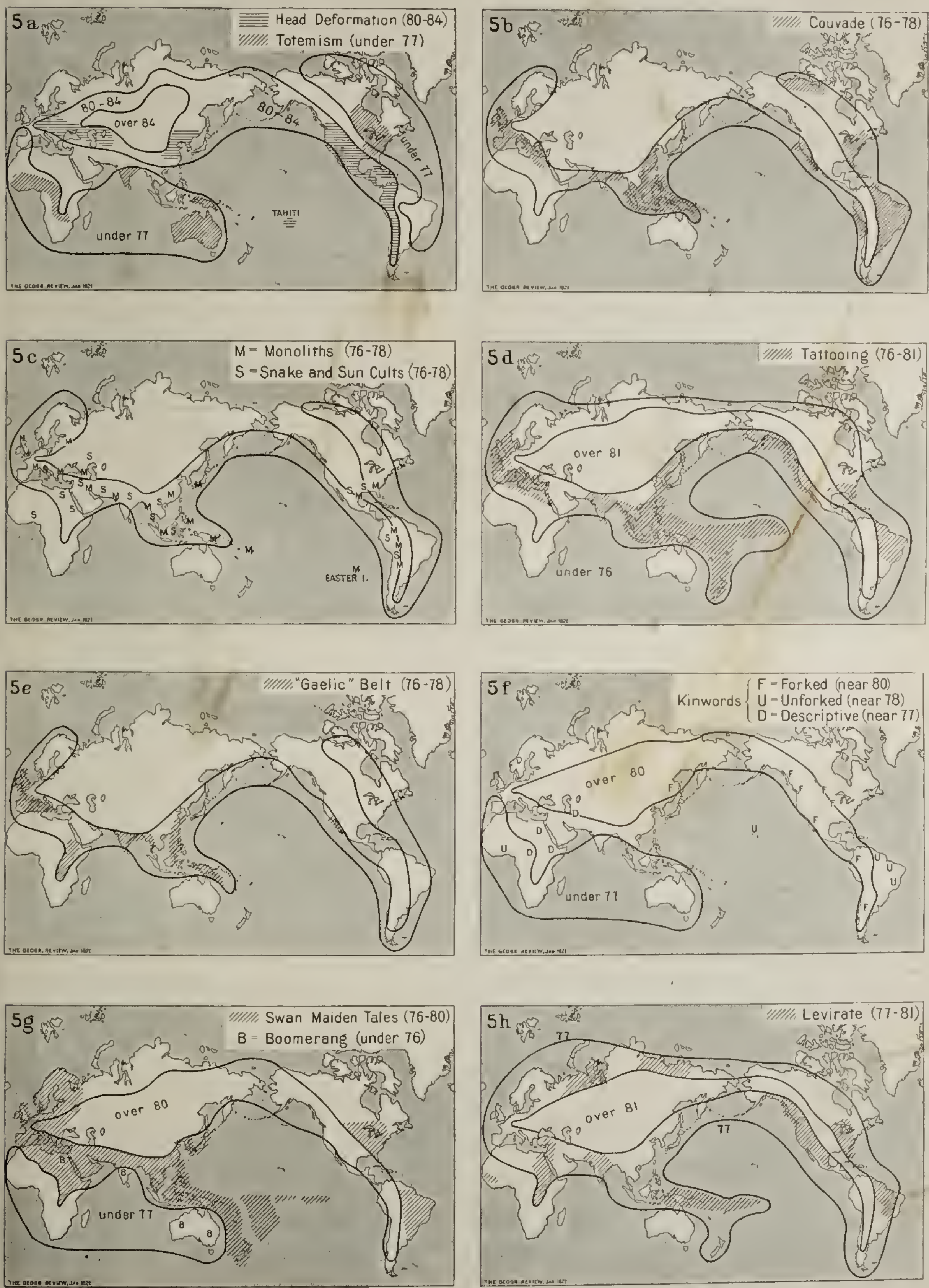

FIG. 5

Another primitive custom which originates in the earlier strata of culture is mummification. This occurs among many of the people using totems, e.g. Dravidians, eastern Australians, tribes of the eastern United States, and through Africa.

The Botocudo

The South American Mousterians, the Botocudo of eastern Brazil, are much nearer to the Australians than to other races. The index is 73–76, the skull is marked by prominent superciliary ridges, by a keel roof, and by a deeply depressed nasal root. The Botocudo have hardly reached the stone age. The women seem to be constantly subjected to barbarous treatment, being scarred and gashed as were some of the eastern Australians. The dwellings of the people are formed merely of branches stuck in the ground and accommodate two or more families. They sleep without any covering and often in the ashes of their fires. The chief differences are in that very variable factor, the color of the skin, and in the lack of hair. The latter may have originated through depilation perhaps assisted by sexual selection.

The Dravidians

The Dravidians of India have been preserved from the stagnation of Australia by the stimulus of repeated invasion. Only a few hill tribes in southern India are so low in the cephalic scale as the Australians, e.g. Badaga and Sholaga (72), the Toda (74) of the Nilghiri Hills, and the Veddah of Ceylon. These Kolarian folk possessed the boomerang, and it seems probable that the very ancient Egyptians, with about the same index (73), used it also (see Fig. 5g). The languages of southern India and Australia are both agglutinative with many suffixes. The curly and abundant hair of the Australian is only paralleled by the allied Todas of India and by the Ainu of Japan, who are slightly higher in the scale.

In group marriages and the allotment of temporary wives at initiation festivals almost exactly the same observances are followed among the Victorian aboriginals as among the Nairs of the Malabar coast of India.

In India and the vicinity we get a continuous series of folk leading from the Sholaga (72) and Veddah (72) up through the other Dravidians (74), the Hindu of Bihar (75), the Santals (76), the Nagas (77), the Kurds (78), the Tates of Caucasia (79), the Baluchi (80), the Parsis (82), the Tajiks (84), and the Galchas (85). This in itself indicates that the center of dispersion was close to India, for nowhere else in the world do we get such a continuous series. Indeed we know that all these folk moved south or southeast, so that their center of dispersion must have been somewhere between the Caspian and Tibet.

Zone IV, Customs of the Folk of the Hamitic Migration

As we progress inwards from the Negro belt we reach migration zones which have moved away later from the original home and which have been

less broken by the vicissitudes of history. It might seem at first absurd to correlate such diverse folk as the following: Hottentots, Copts, Etruscans, Portuguese, Punjabi, Igorots, Moriori, Micronesians, Hurons, Seri, and Yahgans. Yet there is strong evidence of common origin when their geographical position among the migration zones is compared with their anatomy and with their customs and languages.

In the first place all have a head index close to 76 and have regular features recalling the well-known "Dago" or gypsy type. In every case they lie outside a belt of people with Aryan affinities, and there is often a belt of negroid folk on their outer margin. They are nearly all characterized by a belief in such extraordinary customs as the couvade—in fact the "couvade horizon" is one of the most definite of the ethnological strata (see Fig. 5b).

The Couvade and Its Distribution

The world-wide distribution of the couvade, i.e. the custom of a father abstaining from certain foods and practices and at times from all exertion whatever for some days or weeks after his wife has borne a child, has been known since classical times. It has been customary to ascribe it to a kind of paternal forethought for the welfare of the child which has arisen *independently* all over the world. But this theory cannot be accepted when its relation to the Hamitic migration zone is demonstrated.

The couvade is recorded by old writers as occurring among the most primitive folk in Europe, the Basques, among the Cantabrians, Iberians, and Corsicans (Diodorus).[26] All of these have a cephalic index of 76 and belong to the later tribes of the Hamitic-Iberians. Traces of it also occur in several English counties. We hear of it among the ancient Libyans (75) of Egypt. It is found among the Telugu (Telingas) (75) of Madras and in the Nicobar Isles. It occurs right through the Malay islands, as with the Juhuns of Malacca, the Alfuros (76) of Molucca, in Timor Laut, in Amboyna, among the Igorots (76) of Luzon, in Borneo, and in New Britain (76). In the Solomons and New Hebrides Codrington[27] shows that the couvade is found in San Cristoval, Banks Island, Leper Island, and Pentecost Island. This is along the isocephalic line—isokeph—75–76; and here also head-hunting and stonework flourish.

In eastern Asia couvade customs occur among the aborigines of Wei-ning (in Kwei-chau), in upper Assam, among the Miao-tse of southern China, and among the Ainu (76) of northern Japan. In America it occurs among some of the Eskimos (76) and the more primitive Californian tribes (76). Traces are found among the equally primitive Yuchi tribes (76). In South America it is especially prevalent. In Guiana the husband takes to his bed for weeks,[28] and the custom is found in one form or another among most

[26] H. L. Roth: On the Signification of Couvade, *Journ. Anthropol. Inst.*, Vol. 22, 1893, pp. 204–243; reference on p. 206.

[27] R. H. Codrington: The Melanesians: Studies in their Anthropology and Folk-lore, Oxford, 1891, p. 228

[28] E. F. im Thurn: Among the Indians of Guiana, London, 1883, p. 218.

of the Arawak and Tapuyo tribes of Brazil. It occurs also in the less advanced races along the western coast, which thus resemble the Californian tribes in this respect as in so many others.

This couvade horizon, as it may be termed in accord with geological phraseology, is to my mind sufficient in itself to prove the vast importance of the cephalic index as a clue to human evolution. Ling Roth gives a few other examples of tribes practicing the couvade which I am not able to identify, e.g. Zandardan (of Marco Polo), Tibareni (of Pontus), and Cassangi (of Congo); but I suspect that their indices are near 75. As regards every example which I can verify the couvade occurs in the Hamitic-Iberian zone *and nowhere else* (see Fig. 5b). Nor does this system stand alone, though it is perhaps the most readily identified.

The Serpent and Sun Cult

The great serpent cult is of world-wide distribution; and, though it spreads in some form or another throughout later heathen races, it seems to have originated with the Hamitic peoples. The Nagas of the northern Punjab still preserve the worship, which long preceded the Aryan religions of India[29] (see Fig. 5c).

The ancient higher Dravidians of northern India (Asura) had cities and a high civilization before the Aryan invasion, just as had the Iberians in Greece and Italy. They were skilled in astronomy and navigation. The cobra (Naga) was the chief object of their worship, while the sun was also venerated. The sacred scourge and the cobra are identical on the Naga gods and on Osiris of ancient Egypt. Both are seen in the insignia of the priests of the highest American civilizations.[30] This serpent cult is found in a debased form in Kathiawar and in southern India. Kindred religions were carried from India to Java in the seventh century before Christ, and probably the ancient Elamites and the Abyssinians had much the same cult.

The great Yoruba civilization investigated by Frobenius[31] is of this epoch and without doubt represents the lost land of Atlantis.[32] It was founded long before Phoenician times by colonists of the Etruscan race. The statues dug up at the mouth of the Niger are of the same type as the heads from Sardinia. The voyages of Hanno and Necho were the last efforts to follow the old sea route. Desiccation had previously ruined the land routes across the Sahara; but the oil palm, banana, pepper, indigo, bronze, and strange buildings of Yoruba can clearly be identified in Plato's

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[29] C. F. Oldham: The Sun and the Serpent, London, 1905.

[30] See the cap on the chief priest and his "sungal" scourge in the illustration of a Chama vase, *Bur. of Amer. Ethnology Bull. 28*, Washington, D. C., 1904, p. 638.

[31] Leo Frobenius: The Voice of Africa: Being an Account of the Travels of the German Inner African Exploration Expedition in the Years 1910–1912, 2 vols., London, 1913 (translation of the German "Und Afrika sprach . . . ," Berlin, 1913).

[32] The destruction of Atlantis and the deluge myths may refer to the drowning of the coasts of the deep Mediterranean Basin when the land bridge of Gibraltar broke through (see Fig. G. Pl. I.)

account of Atlantis. The Yoruba and Vei tribes have a head index of 76 like all the other Iberian and Etruscan peoples.

The Mycenaean and Etruscan civilizations are so well known that it is unnecessary for me to dwell on their features. The Basques are an interesting relic of Iberian times in that they alone in all Europe have preserved their Iberian language almost intact. In fact it seems certain that there has been a sort of *retrogression* here; for, though most of the Spanish Basques have a head index of 76–78, the language has spread into some of the Alpine Cevenole (83) villages in France. Probably they made common cause against the invading Franks in the far past. I have met with no other example of retrogression that is quite so striking, but doubtless the same phenomenon has affected many minor races. The alliance of Basque with the other Iberian languages of Berber and Libyan is now universally allowed.

If we admit an advanced Iberian civilization in Egypt in 8000 B. C., then in my opinion we should not be surprised to find that much earlier Iberian migrations carried the great part of their cult with them to America perhaps twenty or thirty thousand years ago. No doubt many of the earliest monuments of Egypt and America were constructed of wood and have long ago disappeared. The power to work in granite and other hard materials was but slowly developed. It is possible that these perishable monuments date back to the common Asiatic breeding place, and that in some such fashion may be explained the extraordinary similarity in structure and detail which occurs in the architecture of Yucatan and of Cambodia. The ritual is of course more easily distributed than the architectural skill. We may compare the snake dances of the Hopi and the ritual of Peru with the snake cult of northern India. There is little doubt that the sacred dragon of China, the serpent of Aesculapius, and even the serpent in Eden are developments of the serpent cult of northern India among much higher races than the originators.

Zone V, The Nordic Migration

Immediately succeeding the typical Iberians come the Nordic races. Sergi classes them with the Iberians, while some German ethnologists unite them with the Teuton Aryan peoples. They have larger frames and are usually fairer than the Iberians. They are usually characterized by long, curly hair and flowing beards. In many places we get a merging with true Iberian peoples.

The Druids and Vikings are popular types belonging to the Nordic peoples. The Kabyles, Santals, Ladakhi, Pathans, and Ainu seem to have many features in common besides their cephalic indices. It may be that the Seri of California[33] and many of the Iroquois peoples were originally

[33] McGee states that the outcast Seri called Kolusio "shaved regularly and might apparently have grown moderately stiff but straggling mustaches and beard" (W. J. McGee: The Seri Indians, *17th Ann. Rept. Bur. of Amer. Ethnology,* Washington, D. C., 1898, pp. 1–344).

hairy but have lost this covering through sexual selection or even partly through constant depilation.

Monoliths and Tattooing

Monolithic monuments and tattooing are characteristic of most of the folk on the border line of the Iberian and Aryan zones. Naturally monolithic monuments like Stonehenge are better preserved than the tattooing of our ancestors, but both indicate that the early Britons (76) were akin to the Nordic folk. Monoliths occur throughout western Europe, in eastern and southern Russia, around the Caspian Sea, the Mediterranean Sea, and the Red Sea. They are very common near the Persian Gulf, throughout the Deccan, in Farther India, in Japan, and in much of China. They have been erected throughout Micronesia and Polynesia even to Easter Island. They are especially prevalent in Mexico and Central America, and perhaps the most striking of all are near Titicaca in the central Andes.

It has recently been shown that Melanesians (77) (akin to the Moriori, Caroline, and Solomon Islanders) built the famous Easter Island monuments.[34] Exactly similar heads have been described from Yap in Micronesia where also occur walled tombs like those found in many parts of the Old World.[35]

We know that the Melanesians of New Guinea make long voyages in their huge canoes from Moresby, and no doubt the Easter Islanders did the same long before the Polynesian (83) migrations invaded the islands and wiped them out. Possibly these islands had a more bracing climate in the early days, which incited the natives to build monuments that the languid Polynesian of today has no desire to rival or copy. It may well be that here again we have evidence of the deterioration in climate of our warm temperate regions.

As regards tattooing it has apparently developed slightly later. Of course the custom has died hard; gypsies, sailors, and the lower white classes generally still keep up this habit. Many of them are indeed direct descendants of the folk who tattooed in prehistoric times (see Fig. 5d).

The Japanese (78), Igorot (76), Marquesan (78), and Maori (78) are perhaps the chief exponents of the art. It also occurs in America among the Western Eskimo (78), Haida, Caddoan (Wichita), Kiowa, Sioux (Omaha and Osage), and Chippewa (Ojibwa), as well as among the cognate Carib and Arawak tribes in South America. The Hupa women of California (79?) were marked with two signs on the chin in just the same fashion as the

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[34] For recent discussions of the problem see Scoresby Routledge: Easter Island, *Geogr. Journ.*, Vol. 49, 1917, pp. 321–349; and Mrs. Scoresby Routledge: The Mystery of Easter Island, London, 1919.

[35] F. W. Christian: The Caroline Islands, New York, 1899.

Maoris (78). All these tribes have indices from 78 to 81, and we may notice that the Haida of British Columbia use linear tattoo marks which Christian compares with those of the Marquesan Polynesians.[36]

Semitic and Early Aryan Customs

No myth has received greater support than that of the Lost Ten Tribes. As explained previously, there is much truth in the idea if we realize that the Jews are a very small section of a huge migration dating back for say 50,000 years. Allies of the Jews are found all round the world. The hooked nose recurs in Africa and Melanesia. In some of the northern Solomons, about one man in five has this pronounced feature, and here they are generally known as the "Black Jews" (77). They are more industrious than the Samoans (80–82), and the writer has seen them in Upolu (Samoa) where they are employed on the coconut plantations.

The Syrian Jews were a very advanced race, in fact in their moral and religious beliefs they seem to have eclipsed every race at the dawn of history. But their confrères of Africa and Melanesia have no such high civilization, though many of the customs are similar. Many of the primitive Aryans seem to have been characterized by premarriage communism.[37] Thus the Nagas, Boros, and other tribes of Assam build communal barracks (morongs) for the youth of both sexes. As a result, juvenile chastity is unknown. Tattooing and head-hunting are common, and these tribes often live in pile dwellings. The morongs, jew's-harp, and other features are found in Formosa, Borneo, the Solomon Isles, New Britain; among the Gonds, Kols, Oraons, and Santals of India; and also among the Masai (see Fig. 5e).

To this zone belong the Goidels (Scotch Highlanders), and the description of some of the Assamese and Burmese might almost fit the Highlanders (76). The Khyengs (76) of Burma[38] have a respect for pedigree, and blood revenge is a duty. They are fond of strong drink, are very hospitable, are afraid of the evil eye, have a very clannish feeling, and are notably closefisted. The allied Nagas[39] go further, for they wear a clan tartan and amuse themselves by putting the stone. The tartan kilt also recurs among the Dusuns of Borneo. The Erromangans of the New Hebrides have many customs like the Gaels, e.g. ring stones, keening, funeral feasts, wind-making, etc.[40] The Seri (76) of California[41] have a form of temporary marriage which is only found elsewhere in the ancient handfasting of the Scotch. They keen at the death of a friend as do all the Gaels (see Fig. 5e).

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[36] F. W. Christian: Eastern Pacific Lands, Tahiti and the Marquesas Islands, London, 1910.

[37] S. E. Peal: On the "Morong" as Possibly a Relic of Pre-Marriage Communism, *Journ. Anthropol. Inst.*, Vol. 22, 1893, pp. 244–261.

[38] Keane: Man Past and Present, rev. edit., Cambridge, 1920, p. 184.

[39] W. Crooke: Natives of Northern India (Series: The Native Races of the British Empire), London, 1907, p. 48.

[40] H. A. Robertson: Erromanga, the Martyr Isle, New York, 1902

[41] McGee, *op. cit.*

The Evidence of Kin Words

A very useful branch of ethnology deals with the terms of relationship used by the various peoples. Thus the Semitic and Arabic tribes use descriptive kin words[42] which are also in vogue among Persians, Armenians, Gaels, Scandinavians, and those Africans who are affected by Moslemism (see Fig. 5f). Most of these are close to the Semitic zone of 76–77.

The Hawaiian type of relationship tends to class all the relations of one generation as similarly akin to the person speaking. Hence all the uncles are called "father" while the nieces are usually "daughter." This is called "unforked kinship" and is found among somewhat higher peoples, i.e. Hawaiian (79?), Karens of Burma (78), Japanese (78), Yoruba (76), Tupi (79), and Arawak (78). The other chief system is called the Dakota or "forked kinship." All near relatives connected to the person speaking *through his father* have this fact indicated, and another sign shows the mother relation. This scheme occurs among the Dakota, Sioux, Chippewa, Tlingit (82), Haida (82), Hopi (83), and amid the Chibcha (81), Sipibo (of the Ucayali), and Araucanians (84?) of South America. It also seems to be present among the Gilyaks (86?) of Manchuria. There is also a queer similarity between the kin words of the Tamil (76), Toda (74), and American Seneca (75?), which seems to show an earlier "horizon" of "forked" kin words, but Lowie is doubtful of their connections.

Folklore

The folklore of these Aryan folk has the same basis all over the world. Thus the Micmacs (76) of New York had an evil spirit Lox (the wolverine) which acted just like the Loki of the old Norse (76) legends. The Algonquian Miamis (76?) held séances in which astral bells and winds were made manifest just as in Britain today. The Muskogee stories are described as coming straight from the Old Testament. The Catawbas have fire dances which recall those of the Sabines.

The belief in a virgin birth, in a personal God, and in a future Messiah is prevalent among many of these tribes, e.g. among the Karens of Burma as well as the Jews. The werewolf myths are also ubiquitous, with the natural change to a more familiar animal. Thus we get the werewolf in France, the weretiger in Perak, the werejaguar in the Amazons and the wereleopard in Africa. The myth of Persephone is current in Japan and in New Zealand. The story of Jason is almost world-wide.

The swan-maiden fairy tale[43]—in which the hero sees a number of birds descend from the sky and change into maidens—is universal in or near the Aryan zone. In almost all the stories the birds bathe, and the hero steals either clothes or feathers and so wins a wife. This tale occurs throughout

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[42] R. H. Lowie (Culture and Ethnology, New York, 1917) discusses Morgan's data, but neither writer correlates them with head form. See also Lowie: Primitive Society, New York, 1920.

[43] E. S. Hartland: The Science of Fairy Tales, New York, 1911.

Europe, among the Santals of India, Annamese, Kurds, Burmese, Japanese, Melanesians, Arawaks, and Algonquians.

Correlations in Material Culture

Tools and weapons are often useful guides. Thus the blowgun is found only among the lower Amerinds with an index of 76 or so, e.g. the Iroquois, the Antilleans, and the Jokuns of Brazil. It also occurs among the Malay people of the same zone. The sling bow occurs only in Malay and in the Amazons. Bark-beaters for making cloth occur among the Polynesians and their kinsmen in America. Even tobacco helps us to correlate North and South America. The elbow pipe is found among the more primitive folk in the east of each continent. The cigar is more characteristic of the plateaus and Carib country, where the tribes have a higher index.

The Higher Aryans—Alpines, etc.

It is perhaps well to pause for a moment to consider the composition of the races of Europe today (see Fig. 6). The old ethnological stocks still remain fairly distinct in spite of wars, conquests, and treaties. Nationality is in a basic sense more a question of physical anthropology than most historians would have us believe, though for reasons which I have explained in my earlier paper I am not disposed to place so much stress on stature and color as do many ethnologists.

The Peoples of Europe

There appear to be in Europe representatives of peoples from Africa and from Asia. Of the former we have (1) the old Iberians and (2) many Nordics (see Sergi). From Asia we have probably many Brython and Teuton races, not unlike the Nordics. These are longheads. There are also Alpine peoples (ancestors of the Keltae), such as the early group which may be termed Savoyard-Illyrian. These are roundheads, as are the Cevenoles and less brachycephalic folk like the Slavs. Later again are the non-Aryan Magyars, Finns, Lapps, and Turko-Mongols, who are numerous only in the north and east. The chief European countries may therefore be subdivided as in Table V.

Table V and the accompanying map (Fig. 6) are, I think, very interesting in view of the recent changes in the map of Europe. The Austrian Empire has been dismembered into the fairly homogeneous groups of Magyar, Austrian, Czecho-Slovak, and Serb-Croat-Slovene nations. The Rumanians have received several millions of similar-speaking people, who are however chiefly of Cevenole origin. They are more nearly allied to the Abruzzi and Provençal than to the Wallachian. We see, however, that France has in the past managed to incorporate several absolutely distinct races, and so has Italy. Germany includes dolichocephalics in the north, the middle Germans are allied to the Slav, while the Swabians are very brachycephalic Alpines.

It may be objected that though the Slavs have the same head form as the

FIG. 6—Map showing the correlation of the component nations of Europe. Compare with Table V opposite. The broken lines on the map represent linguistic boundaries.

TABLE V—CORRELATION OF THE COMPONENTS OF THE CHIEF NATIONS OF EUROPE (GENERALIZED)

COUNTRY	PRIMITIVE IBERIAN (CEPHALIC INDEX 75–77)	NORDIC AND TEUTON (C.I. 77–80)	DOLICHO-CEPHALIC ALPINE (C.I. 81–85)	BRACHY-CEPHALIC ALPINE (C.I. 85–88)	ASIATIC—NON-ARYAN (C.I. 81–87)
Ireland Scotland	Pict? Goidel?	Goidel? Some Saxons			
Wales England	Pict of Devon	Brython Saxon			
France	Basque Dordogne	Norman Gascon, etc.	Cevenole Frank	Savoyard	
Germany		Prussians Saxons, etc.	Bavarian (Austrian)	Swabian	
Spain Portugal	Basque Central Spanish Portuguese	Andalusian, etc.	Few Galician		
Norway Sweden	Few in mountains	Bulk of people	Few in S. W. (Finn)		Lapp (87) Finn (81)
Switzerland				Swabian Ladin, etc.	
Italy	Corsican Etruscan	Sardinian Sicilian	Lombard Umbrian	Savoyard Ladin, etc.	
Greece	Pelasgian	Type Greek	Many Slavs	Albanian	Turk (85)
Bohemia Poland			Czech and Pole		
Serbo-Croatia			Many Croats	Croat and Serb	Turk (85)
Hungary		Some Teutons	Magyar of Plains	Magyar of Carpathians	Magyar (largely Alpine now)
Rumania			West Rumanian and Wallachian		
Bulgaria			Bulgar		Turk
Russia		Some Teutons	Lithuanian Slav Pole		Finn (81–82) Cossack (84)

middle Germans, Finns, and Wallachians, yet there are great differences between them. My opinion is that they are all peoples of the same migration zone, who have however arrived in Europe at very different times and have in some cases started off from different areas in Asia. Thus the Germans came from that portion of the zone nearest to Europe, i.e. in or around the Pamirs. Hence their language is Aryan of a somewhat primitive type. The Finns came from a very distant portion of the zone—probably from the Altai region in Siberia—hence their language is strongly affected by the (later-developed) Tungus speech which was originating here. The Slavs are a race who came from an intermediate breeding place. The Magyars probably came at a much later date from the same cradle as the Finns.

Where the isopleths of head form (isocephalic lines) on the map are crowded together, as in central Italy, we get very sharp differences in ethnology. Where they are widespread, as in northern France, it is probable that we have the greatest hybridization occurring. Finally we must bear in mind what may be called the *mass effect* of a people. In central Europe the very brachycephalic people—though ethnologically higher—were on their arrival more primitive than the southern dolichocephalic people and also at first less numerous. Hence we find them dominated by an earlier civilization (the Roman) and modifying their language accordingly.

We see that the same thing has occurred in Bohemia and Serbia. Here the Alpine folk have adopted much of the Slav language and culture. It must not be forgotten that their own tongue was also Aryan and therefore easily swayed either to Latin, German, or Slav speech. This aspect is discussed later.

Finally, if we turn to China we see there an "Alpine" people coming down in vast hordes into a dolichocephalic—one might say Aryan—region. Here the mass effect causes the Mongolian culture to submerge the "Aryan." But ethnological research can readily detect the primitive peoples covered with a Mongolian veneer.

In Figure 6 we see graphically how difficult it is to disentangle the components of the various nations. Almost the only fairly homogeneous race is the Swiss (86–89) who are all Alpines with very round heads. Yet here there are four languages spoken habitually: i.e. German, French, Italian, and Romansh, besides various dialects!

Following Ripley we find the key to lie chiefly in the cephalic index and in the physiography of the region. Speaking generally of the central regions we find that the Teuton on his appearance drove the Alpine up the valleys, while the Slav drove the Teuton up in turn. This is well illustrated in the basins of the Inn and the Adige.

It is an axiom in these studies that scattered peoples confined to mountainous regions are usually relics of an early migration. The habitat of a tribe is determined by its powers of resistance to aggression. In Europe we have a double confusion which is primarily due to migrations coming in from Africa and Asia, possibly simultaneously; while, more unusual still,

there is no doubt that a large number of very broadheaded Alpines preceded some of the longhead Teutons and most of the other Alpine and Slav races. This is contrary to the general rule that migrations occur in the order of the cephalic index, i.e. from longhead to broadhead.

Scattered Peoples in the Mountain Regions of Europe

We find that the most inaccessible regions in Europe, away from the main corridors and among mountains, are universally occupied by very brachycephalic peoples. Among these are the Albanians, West Rumanians, Rhetians, and Savoyards. These tribes have been herded into the hills and disrupted by Teutons, Franks, Lombards, Huns, and Slavs. Only the dark Provençal and Cevenole of slightly lower cephalic index have shared their fate and may belong to the same period of migration. The Spanish folk (78–80) and those of Guyenne (78–80) have most points in common (save color) with the Nordic peoples (78–82) around the Baltic and North Seas. Possibly they are of the same migration, though one section may have arrived by way of Africa, and the other by way of Anatolia or southern Russia. They seem to have driven the broadheads into the coasts or hills, as in the southwest of Norway and in Poitou.

It seems likely that a medium brachycephalic race followed close after them (83–86) and passed along the plains between the Alps and the North Sea. They occupied the woodlands of Germany and Burgundy driving the dolichocephalic Teutons somewhat to the north and west, and it may have been a similar later thrust that caused the Saxon descent on Britain. These Alpine folk sent a long tongue of Bavarians along the Danube valley. Another pressed to the south, probably leaving many tribes in Rumania, and settled in northern Italy, especially in Lombardy and Umbria. A later stage saw the advance of the western Slavs, who occupied Bohemia and Serbia. They were displaced from Hungary by a much later Asiatic migration of Huns. The latter, however, have incorporated so much Aryan (Alpine) blood that, like the Turks, their language is perhaps the chief feature distinguishing them from their neighbors.

The chief feature of later European ethnology is the resistless spread of the Slav peoples. They have swamped all relics of the longheads who used to inhabit their region. They have driven a Polish wedge between the Prussians and Saxons, and a Bulgar and Greek wedge right down into the southeast of Europe. There is little doubt that Slav blood is quite as important as Nordic blood among the Greeks, while the old Pelasgian (Iberian) blood is only found in Attica and Thessaly.

Alpines in Asia

Although the Alpine folk of Europe are an exceedingly important constituent, their numbers are almost negligible compared with their kin who still remain in Asia, mostly to the east of the Aral desert. Here they occupy

almost the whole of Siberia and Manchuria. Among primitive peoples of earlier origin are the Ostyaks of the Yenisei (76), the Altaians (79), and the Dungans of Kulja (in Turkestan) (79). These are dolichocephalics who have been driven to the tundra and up into the mountains by the overwhelming hordes of Alpine folk. Their culture will doubtless be found to resemble that of their kin in Europe, but I have no data available.

Among the more brachycephalic folk (83) are the Paleo-Siberians (Czaplicka) comprising the Chukchi, Yukaghir, Koryak, and perhaps including the Gilyak of Saghalien. Most of these tribes have a similar culture. The family is the chief unit, the elder people rule and often have shaman powers. Blood revenge is obligatory, though sometimes compensation is accepted (Gilyak). Some of the bear festivals of the Gilyaks have customs recalling the Greek Olympic games. Levirate (compulsory marriage with a brother's widow), lack of chastity before marriage, and group marriage recall the customs of the somewhat earlier peoples of the Aryan clans of Assam. Serving sometimes for three years is necessary to procure a wife among the Koryaks, while the myth of Lot is a well-known folk tale among the Chukchi. A mock struggle at the wedding is a development from marriage by capture which characterizes almost all the tribes of Siberia, from these Paleo-Siberians up to the Chinese themselves.

The Tungus

Somewhat later in development is the Tungus group of people (84–85), who are allied to the Finns and Turks in language and also resemble the Manchus in certain particulars. They have many of the characters of the typical Mongol but are in general more shapely and active with a quick intelligent expression. "All observers speak in enthusiastic language of the temperament and moral qualities of the Tunguses. . . 'Full of animation . . . always cheerful even in the deepest misery, holding themselves and others in like respect, of gentle manners and poetic speech, obliging without servility, unaffectedly proud, scorning falsehood, and indifferent to suffering and death—the Tunguses are unquestionably an heroic people'."[44]

The shaman is the most characteristic feature of their culture. He is the leech, soothsayer, and priest. Some shamans are hereditary, some are elected; and they may be either male or female.

Further to the east are other Alpine folk such as the Dauri of the Amur. Allied clans have tall stature, somewhat regular features, brown hair, light eyes, and even a florid complexion. They are met with in Korea, Manchuria, and parts of northern China. I have no data on their customs.

Marriage Customs

The levirate is observed by many races of the Aryan zone. In Asia and Africa a few of the lower races such as the Gonds and Semites, the

[44] Élisée Reclus: Nouvelle géographie universelle, Paris, 1881, Vol. 6, p. 712.

Gallas, and some of the Zulu and allied tribes also conform. Generally speaking, however, the custom is confined to races between the isokephs of 78–80. Westermarck gives the following tribes: in America, the Kwakiutl, Tlingit, Oregon, and Miwok (Moquelumnan family) of the western coast, the Wyandot (Huron), Chippewa, and Shawnee, the Aztec and Maya, the Arawak, Tupi, and Warrau; in Oceania, the Samoans, New Caledonians, New Britain and Caroline islanders, and many Malay tribes; in Asia, the Ossetes and Kurds in the southwest (see Fig. 5h).[45]

All these races have relics of marriage by capture, usually taking the form of a mock struggle. But it is significant that Westermarck remarks of the Chinese, "Of capture of wives there is no trace, not even among any of the ceremonies." The ancient Teutons and Slavs really *captured* their wives while among the western Slavs the custom persisted till the last few hundred years; but, though we may be sure that the earliest Chinese also had the same practice, their culture and development have progressed so far that no memory of it persists.

Marriage and social organization in North America have been studied in some detail and agree to some extent with the isocephalic lines. We find that in the Huron tribes (73, etc.) the primitive matriarchate obtained, as in southeastern Australia. Most of the eastern tribes (75–78) had strong exogamous rules. Among the lower Pacific coast tribes (78–80) the clan disappears, and real purchase of brides occurs just as it did among the Romans and Teutons. The Kwakiutl and allied tribes also purchased their wives. The Pueblo Indians (80) are monogamists, and the status of women is higher than in most tribes. The wife may dismiss her husband on a slight pretext. Other social features were more primitive.

Late Aryan and Alpine Peoples in America

Owing to the enormous distance between Europe and America (via Asia) we cannot hope for very exact correlation between tribes on similar migration zones. Moreover, mixing and hybridization became much more general as the earth became fuller. Few of the Americans, for instance, retain the well-developed hair and beard of the typical Alpine.

A number of customs have a world-wide distribution along the belt of 79–84 which we are now considering.

Head Deformation

Traces of this weird custom are found in the Caucasus (ancient Cimmerians), in the Crimea, in Hungary, Silesia, Belgium, in France and French Switzerland, especially in parts of the Pyrenees and the French Jura. In Asia it is, or was, common among the Turkomans (83). In Tahiti (78–84) it is very marked. America, however, is the classic country of

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[45] E. A. Westermarck: The History of Human Marriage, London, 1891.

head deformation. In North America intentional deformation is found among the Natchez and the allied Muskogean tribes (82). It exists more or less from the Columbia River (Salish and Chinook, 80) down the coast to Peru. It is characteristic of the Maya (83) and Toltec people and the tribes of the West Indies (83). It is stated to be difficult to distinguish certain flattened skulls of the Crimea from those of Aymará of Peru.[46]

The use of the vapor bath spreads from Lapland through Siberia and down the northwestern coast of North America. The religions of all these brachycephalic peoples (80–85) are similar. The belief in shamans and the use of magic and jugglery in sickness are universal. Blood revenge, political organization, carved houses, mortuary columns, and other features are common to two such widely separated brachycephalic tribes as the Haida of British Columbia (82) and Polynesians of the same head form.

Ritual and the Zodiac

Holmes has noted a remarkable similarity between the architecture of Cambodia (82) and Yucatan (83). The temple pyramids in both cases are approached by four stairs with serpent balustrades. The altars are similar. There are even similar dwarf Atlantean figures supporting the doors, and some of the figures show whiskered men.[47]

Even more remarkable is the identity of the signs of the zodiac in Asia and in Peru. The ram becomes the llama, the bull is the stag, the twins are man and woman, the crab is the octopus, the lion is a puma, the virgin is the maize mother, the scales are forks, and the bowman is an arrow, etc. The Maya signs are similar though not identical.

It is not yet possible to show all the stages in the migration, but that the eastern Alpine folk (82) passed to America, probably via the Bering Corridor, can hardly be doubted. Possibly this passage occurred in the Azilian period when, as we know, their more primitive kin invaded Europe.

The general trend of the isocephalic lines seems to show that all the tribes came in from the northwestern corner. It is difficult to conceive how any direct migration from Europe can have taken place. The climatic features have been adverse, and no land bridge has existed during Pleistocene times. There is no doubt that surges from the eastern coast of America towards the west have occurred, but these were only ephemeral and of little importance in the grand problem. In America as elsewhere the most highly developed culture is not, however, usually associated with the most extreme brachycephalism.

In the northern continent the Mayas, Aztecs, and Pueblo Indians had advanced farthest on the path of progress. Their head index is about 82, whereas that of the Plains Indians of the central Mississippi rose to 88

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[46] Paul Topinard: Anthropology, London, 1890; p. 179.

[47] W. H. Holmes: Bearing of Archeological Evidence on the Place of Origin and on the Question of the Unity or Plurality of the American Race, *Amer. Anthropologist*, Vol. 14 (N. S.), 1912, pp. 30–36; reference on p. 35.

(see Fig. 2). In the same way in South America there were four great civilizations, Inca, Aymará, Chibcha, and Calchaqui. I am not able to get satisfactory coefficients; but these also would appear to be about 83, while the unprogressive Araucanians of the far south are 86 and some of the Bolivian Indians 88.

It is noteworthy that the very high indices occur only in three or four isolated districts in America and do not form a large compact group as in Central Asia. These American districts are so far distant from Asia and so disrupted that one wonders if these forms have developed *in situ*, perhaps under stimuli of drought, competition, and elevation such as I postulated in Central Asia. This problem can only be solved locally.

The tribes of America have in general been classified linguistically (see Fig. 2). Nothing else is possible at present, but a scheme which groups Alaskans (84) with Déné tribes (77), or groups Algonquians of various stocks from 78 to 71 or Aleuts (79) with Greenlanders (74) does not appear to the writer to be either genetic or final. Great language *transgressions* have certainly occurred in America as in Europe. The *dominant* race (whether dolichocephalic or brachycephalic) has impressed its speech on the weaker race, but without altering the other cultural features to a corresponding degree. We may hope that in the future the American zones may be disentangled and correlated with the better known races of the Old World.

The Tibeto-Chinese Group

In many respects the Chinese, who are the dominant members of this group, are worthy of the highest respect. Their Empire has remained virtually continuous for 5,000 years, in fact since the dawn of history. With each century more and more of the surrounding tribes have become amalgamated with it, and it is for this reason that it is the great rival of white dominance. The Empires of Elam, Egypt, Babylon, Persia, Macedon, Rome, and Spain have waxed and waned, and their peoples have become scattered and almost negligible, yet the millions of China still remain consolidated and ready for the awakening that is coming. This is of course due largely to their environment remaining much more favorable than in the other empires.

At almost any period anterior to the last hundred years the Chinese held a worthy place among the nations, so that none should blame them if they condemn the arrogance of the upstart nations of today. Their Empire is so huge and populous that we must first ascertain where the typical Chinese folk dwell. Even when they dwelt in the Tarim Basin the old legends indicate that written characters had superseded the knotted cords (compare the quipu of the Incas) for the purpose of keeping records. The matriarchate had died out, marriage was instituted, and musical instruments were invented. Astronomy and silk weaving were practiced. All this is placed anterior to 2600 B. C. in the earliest Chinese histories.

About 2600 B. C. they migrated through the "Jade Gate" into the upper Hwang Ho basin, and for 2,000 years their capital was in Shensi. There are in existence bronze bowls dating from 2000 B. C., and a large number of beautiful works of art in jade date back to 1000 B. C. Their culture seems to have equaled that of any of the occidental empires. About 800 B. C. the phonetic seal writing was invented, and about 550 B. C. lived two of the world's greatest religious teachers, Confucius and Lao-tse, while Mencius was 200 years later. The Great Wall was built before 200 B. C.

About 120 B. C. their Empire extended to Yunnan. In 30 A. D. the capital was moved eastward into Honan and in 1264 A. D. to Peking by the Mongol Kublai Khan. Marco Polo's record deals with this period when the Mongols and Chinese conquered half the known world. Jenghis Khan and Tamerlane are two other emperors of the thirteenth century who made the Mongol power dreaded by every other nation.

The highest Chinese type is probably still to be found in the northwest along the valley of the Hwang Ho. Data as to the head form of the peoples of Central Asia are not available. Ripley shows a solid block of very brachycephalic tribes (over 88) extending from the Himalayas to Lake Baikal.[48] All this region is now very inhospitable and sparsely inhabited, but these conditions have only supervened within the last few thousand years.

The Aurignacian Belt of Low Stature

It seems likely that there was a large population of short Aurignacian peoples in southeastern China, who resembled the modern Eskimo. Hence in this portion of China, which is the chief source of the well-known Chinese coolie, we find squat figures, dark skin, and high cheek bones, which are less common in the regions of higher cephalic index of Tibet and northwestern China (see Fig. 7).

The same short uncouth figure is found round the periphery of the true Mongolian region and seems to be identifiable in Deniker's tables of stature. Thus it occurs among the Lapps (152 centimeters), Samoyedes (155), Chukchi (165), low-class Japanese (157), southern Chinese (161), Annamese (157), and especially in the Mongolians from Burma to Timor (158). All these peoples are near the Aurignacian migration zone of 74–75. We find other races in this zone with the squat figure, as among the Fuegians (157) and some Tupi-Guaraní (157–160) of Brazil. It is of course a feature of the Aurignacians of South Africa—the Bushmen (153). The same zone in Spain gives us Moors (162), Portuguese (163), Corsicans (162), and some primitive French folk. Lastly it is general throughout southern India among the Dravidian folk, i. e. Kurumba (155) and Chota Nagpur tribes.

Early Mongol Civilization

I suggest therefore that some of the accepted salient features of the Mongolian are relics of a very much earlier migration. In effect they show

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[48] Ripley, *op. cit.*, p. 42.

the hard conditions which the original Aurignacian suffered in his fight against the inclement environment of the Ice Ages. These features are not found so generally among the Mongolians who determined the wonderful Chinese civilization of the centuries.

There seems little doubt that the earliest civilization was developed by the Proto-Mongols, possibly in Turkestan. They were connected with the Sumerians of southwestern Persia and with the peoples of Askabad. Indeed Turkestan is now the only flourishing region which still remains in spite of the secular desiccation which has ruined every country round it.

We find a common tradition among the Chinese and the Akkadians, who were the successors of the Sumerians. Thus the Babylonian priest Berosus (third century before Christ) describes the earliest dynasty as consisting of ten kings and enduring 432,000 years. This is exactly the same as the Chinese story. The Sumerian art, town life, and religious ideas are also said to be closely akin to those of the Chinese. At Susa (Persia) we get artifacts showing a very high civilization at a depth of 50 feet below the surface. They are estimated to date back 14,000 years. At Askabad in Turkestan are similar relics which greatly antedate the Egyptian civilization.

FIG. 7—The Aurignacian zone of low stature. Compare with zone 74 (cephalic index), Fig. G, Pl. I.

The Chinese many hundred years ago had evolved a civilization to which we are only now attaining. As A. H. Smith wrote, they are characterized by "a love of industry, peace, and social order, by a matchless patience under wrongs beyond cure, by a happy temperament, by no nerves, and a digestion like an ostrich!" These are pre-eminently the traits which are needed in the workaday world of today. When we realize that the Chinese have natural resources at their disposal which are unrivaled (except in North America), it is obvious that only unremitting diligence, thrift, and sobriety will enable the white man to resist the "yellow peril." This is not a peril of military invasion, such as that by the Huns of old, but an economic peril for which I see few nations of the world educating themselves.

It is often objected that the Chinese are decadent because they have lagged behind in the race. To my mind this is merely a question of wrong education. The World War was largely due to a wrong education which resulted within forty years in the Germans glorifying military aggression. The stagnation of the Chinese was due to a sort of "Yellow China" policy, not very remote from "White Australia" policy. But this is now being abandoned throughout China. We shall see in the next fifty years a new China which will dwarf the old régime just as New Japan, the Britain of the Orient, far surpasses the ancient Empire of the Mikado.

Part V

Environment and Civilization

The foregoing sections aim to demonstrate that civilization is almost wholly a question of environment, at least since the dawn of true civilization in Asia. Table VI shows the ethnology, climatic control (temperature), and date of some of the chief civilizations. From this table we see that excluding the lowest races (75 and under) most of the races have been pre-eminent at one time or another. In America the Maya (700 A. D.), Aztec (1200 A. D.), and Inca (1500 A. D.) also flourished and had their day.

TABLE VI—THE RISE AND FALL OF CIVILIZATIONS (GENERALIZED)

APPROXIMATE DATE	NATION	ZONE	CEPHALIC INDEX	TEMPERATURE	
				SUGGESTED ANCIENT	PRESENT
B.C. 10000?	Proto-Mongol	Early Mongol*	83?	65°F.	60°F.
8000	Sumerian	Early Mongol	83?	74°	78°
6000	Akkadian	Semitic	77	74°	78°
5000	Egyptian	Iberian	76	65°	70°
4000	Chinese (in Northwestern China)	Early Mongol	85	55°	50°
2000	Hittite	Alpine?	83	58°	60°
2000	Persian	Aryan	77	68°	70°
1000	Etruscan	Iberian	76	63°	65°
300	Macedonian	Alpine	81	63°	65°
A.D. 0	Roman	Alpine?	81–83	60°	62°
1100	Saracenic	Alpine and Semitic	?	68°	70°
1500	Spanish	Aryan	79	About 2000 B.C. 58°	60°
1800	French	Alpine largely	80–83	52°	55°
1900	British	Aryan	79	46°	50°
2000	U. S. A.	Aryan	79	46°	50°

* Early Mongol and Alpine races are variants in the same zone.

The races with cephalic index above 85 do not appear to have attained eminence. In Europe they have formed considerable but not preponderating proportions in the Roman and French empires. Probably they show their chief merit in the arts, for many of the most famous poets, artists, and men of intellect generally are Alpines from South Germany, Switzerland, and northern Italy. This in my opinion is the highest type living in Europe, and under forthcoming settled conditions we may also expect great things from the western Slav races who are of much the same strain (see Fig. 6).

Furthermore we have seen that it is something very like accident which has determined whether a race shall migrate from Asia to a region of

stimulating climate and bountiful resources like Britain or to the hot enervating Malayan jungles or to the dreary cold of Tierra del Fuego.

What has caused the rise of a race and its decay some thousand years later? Huntington believes that it is very largely a question of climatic change. I do not propose to go deeply into this question but only to discuss the Table VI and the map which is given as Figure H, Pl. I.

If we glance at the temperatures of the ancient civilized lands we see that, speaking generally, the modern civilizations are in cool moist climates, while the sites of the ancient civilizations are nearly all either arid or hot or both.

On a map of the world let us insert the isotherms, not, as usually shown, reduced to sea level, but as they actually exist, modified by elevation (Fig. H, Pl. I). We find that the centers of advanced civilization occur very close to the "actual" isotherm of 50°F., and this is the case in both hemispheres. Thus in the south we have Buenos Aires, Valparaiso, Durban, Melbourne, and Wellington, N. Z. In the north are Seattle, Chicago, New York, London, Paris, Berlin, Peking, and Tokyo. Winnipeg, Montreal, and Petrograd are almost the only large centers on the isotherm of 40°.

Now let us look at the "actual" isotherm of 60°. Here or near are many large cities, which in times past have been of imperial rank, Rome, Athens, Samarcand, and Nanking. We know that they were the centers of flourishing nations one or two thousand years ago. If we take the "actual" isotherm of 70° we find it passes through Egypt, Mesopotamia, the Indus Valley, Cambodia, inland Ceylon and Java, and the Maya region of Yucatan. Most of these were centers of civilization in prehistoric times, about 2000–4000 B. C.

Poleward Movement of Civilization

Speaking generally we may say that the belts of *civilization* move poleward. I have shown in my earlier paper (Climatic Cycles, 1919) that the *isotherms* and *desert belts* are moving poleward as the earth heats up after the Ice Age. We can hardly escape the conclusion that our boasted civilization, like our ethnological status, is determined by changes in temperature and rainfall.

It is unnecessary to describe the evidence from which we know that the climates have altered within the last 3,000 years. Huntington has dealt with it very fully in various notable books. Hobbs gives a most interesting account of the extraordinary change in the Nile Valley and especially in the Kharga Oasis. "For a period of at least twelve years no rain has fallen in the inhabited portion of the depression. There is, none the less, abundant evidence that in earlier times the region was more favored by climate and supported a large population." Heavy deposits of tufa enclosing leaves of oak are found in the Wadi Refuf near by.[49] The writer has examined exactly the same type of deposits in the steep gullies of the Flinders Range

[49] W. H. Hobbs: A Pilgrimage in Northeastern Africa, with Studies of Desert Conditions, *Geogr. Rev.*, Vol. 3, 1917, pp. 337–355; reference on p. 353.

(Depot Glen) in South Australia, where, in a similar latitude, the desert is also creeping polewards into the less arid regions.

The climatic stimulus has been more marked near the cradle of mankind than anywhere in the world, and we have to thank this factor for the evolution of man from the *Pithecanthropus*.

We may separate the regions of Tibet and northwestern China from the remainder in Table VI. Here the temperature has probably fallen somewhat, owing to uplift, but the aridity is the controlling factor. This is a rain-shadow desert and so is not affected to such an extent by the secular swing of the climates. In the other regions we see a steady progression from 78° in Persia to 50° in the United States. In the table I have ventured to insert tentative temperatures to indicate the conditions when flourishing civilizations occurred in the localities named. It will be seen, I think, that, although temperatures in the older centers were more comfortable in the past and less comfortable in Britain and northern Europe than now, it is the movement of the desert belts which has chiefly determined the decay of the old empires.

It may be objected that if Scotland were four degrees cooler in 2000 B. C. we should have had a glacial age in the Highlands. I suggest that the corries were deepened considerably even so late as this date, though no moving glaciers were formed.[50] The great importance of late cirque or corrie erosion is not yet fully recognized.

The Zoning of Civilizations

In the map (Fig. H, Pl. I) I have attempted to synchronize the various civilizations. I assume that colossal buildings like those of Boro Budur in Java, Angkor in Cambodia, or the ruins of Titicaca in Bolivia imply many thousands of years settlement before the temples were built. Thus we may perhaps class in the first epoch the Sumerian (and Proto-Mongol?). In the second epoch are the Akkad and Egyptian. In the third epoch are the early Chinese, the Cambodian, the Hittite, and possibly the Maya of Yucatan and Chibcha of Colombia. In the fourth are the Inca and Aymará civilizations of the Andes, the Greek and Roman, and the Toltec. In the fifth are the hill civilizations of Java and Ceylon, Spain, and central India. Finally today we have the sixth epoch with the centers already described. While opinions may differ as to the details of this generalization, yet I think the main principle that civilizations occur in zones must be admitted. One very important conclusion can be drawn from the diagram. If the civilizations grow up in climatic zones, they must be more or less parallel to the equator. We have seen in the early migration maps that the chief corridors are determined by the topography even more than by the desert and forest belts (climatic control.) Let us look at America. Here the migration zones run primarily north and south. Hence they cut

[50] Griffith Taylor: Physiography and Glacial Geology of East Antarctica, *Geogr. Journ.*, Vol. 44, 1914, pp. 365–382, 452–467, 553–571; reference on p. 369.

across the civilization zones, and so we find the anomalies in culture which have made the ethnology so confused. Thus the Alpine tribes who occupied the portion of their special migration zone most favorable for the development of civilization built up the Inca and Aztec cultures, while their blood brothers who were pushed away towards the south remained in a savage state. For the same reason the Yahgans, whose ethnic status was equal to the Etruscans and Gaels, found all their time occupied in searching for food.

In Africa we see the Bantu of the plateaus dominating the Bantu of the coast. In Europe the climatic and ethnic zones are more or less parallel, and the distinction is not so obvious. Yet the ancient Irish Goidel is kin to the civilized Etruscan and Cretan as well as to the savage Todas of India and Nagas of Assam. The Irish tribes inhabited a cold, wet, outlying portion of Europe with the result that right into the Stuart period they were probably the most savage tribes in Europe. To realize this we have only to read the contemporary descriptions by Fynes Moryson (A. D. 1600) or by Spenser and Raleigh. Moryson saw "Young maids stark naked grinding of corn with certain stones to make cakes thereof."[51] Another traveler was regaled by Chief O'Kane in Ulster. "He was met at the door with sixteen women all naked except their loose mantles. . . . Soon after O'Kane, the lord of the country, came in all naked excepting a loose mantle and shoes which he put off as soon as he came in."[52] The Todas wear exactly this type of cloak, as Gomme suggests.

The earlier Irish warrior when he killed his enemy broke his skull, extracted his brains, mixed the mass well, and, working the compound into a ball, carefully dried it in the sun and produced it as a trophy of valor. He carried the heads of the slain at his girdle just as his blood brother does in Malay and elsewhere. In the interments of the Long Barrow period headless trunks are frequently met with, as are also heads buried separately;[53] so that head-hunting was no doubt as prevalent with the early Irish as with the Dyaks.

No Negro tribe has ever reached a high state of civilization. Possibly the most advanced was the Yoruba State on the Niger, but we have seen that this is due to Etruscan influence. This also accounts for their very advanced type of speech. Yet in higher zones it is obvious that all the races have worthy representatives. The Semites (72) at the time of David produced some of the noblest concepts of religion, 500 years before Confucius lived (B. C. 500). The Cretans (75) had a wonderful civilization before the time of Homer. If on the whole the world seems now to be at the feet of the folk of the Aryan zone (76–79) this is due as I have tried to show to many different factors. The future, in my opinion, belongs to the

[51] Fynes Moryson: A History of Ireland from the Year 1599 to 1603, 2 vols., Dublin, 1735; reference in Vol. 2, p. 372, cited by G. L. Gomme: Ethnology in Folklore, London, 1892, p. 178.

[52] Moryson: An Itinerary, 4 vols., London, 1617; reference in Vol. 4, p. 181, cited by Gomme, *op. cit.*, p. 179.

[53] Gomme, *op. cit.*, pp. 146–149.

Alpine races and later to the Chinese unless the white race conquers some of its pet vices.

In conclusion one cannot but realize that, though evolution is governed by fixed laws, these laws have little regard for the individual and not much more for the race. Mighty consequences for good or evil have resulted from what seem to be trivial occurrences in the life of a race, such as the direction of a migration. These appeared of such small importance at the time indeed that the tribe could not possibly have controlled them, and yet one path led to empire and the other to extinction.

Part VI

The Distribution and Evolution of Languages

I have been unable to find any modern geographical treatment of the languages of the world. Too few workers in natural science seem to realize the invaluable help they may bring to research by charting their results—in effect, by using isopleths. In the present paper I have applied the methods used in geology and meteorology with considerable advantage to the studies of evolution and linguistics.

Principles

In the first place there are several outstanding principles which may be profitably considered.

1. In languages, as in evolution generally, we may apply the phrase *ex oriente lux*. All the chief languages may be traced back to the Asiatic cradle, which indubitably lay in the Persian and Turkestan areas.

2. The most primitive languages are now spoken in the outermost zone surrounding the center of dispersal. Thus Gaelic is the most primitive Aryan language. Latin is probably next; then come Greek, Teutonic, and Slavonic; and lastly Armenian and other Alpine languages. The earlier families are grouped in order of development outside the zone of the Aryan family (see Figs. 6 and 8).

3. Much confusion has resulted because many languages have been preserved by three major methods, which result in what may be termed *fossil*, *highland*, and *migrant* varieties. The last is the most important and the other two are often wanting. For instance Sanskrit is a fossil language buried under later strata of Prakrit, Pali, Pushtu, etc. Probably its migrant form is best represented in Lithuanian, but it is most important to realize that the Galcha mountaineers on the Hindu Kush (Siah Posh dialect) have preserved a very close approximation to the ancient Sanskrit (see Fig. 8).

4. The geological analogy of *inliers* (where islands of older strata project up through newer strata) and *outliers* (where islands of later strata are left isolated by the removal of their connecting deposits) may also be applied to comparative philology. Thus in the map of Europe (Fig. 6) the Basque

region is an inlier of Iberian speech which projects through the surrounding waves of Romance languages. The Pelasgian relics in Greece are inliers amid the much later languages which constitute Greek. In China the Lolo peoples occupy an inlier amid the encircling Mongolians. The Galcha are probably inliers among Mongolian peoples (see Fig. 8).

Outliers are more numerous, and the three Asiatic languages, Lapp, Finn, and Magyar, are good examples. Their congeners are to be found far away in Siberia, but we know that these tribes extended for a time right across Russia.

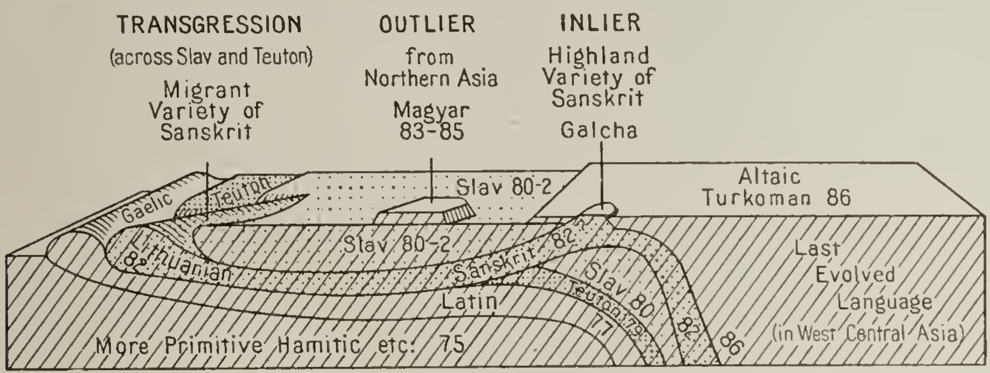

FIG. 8—Block diagram illustrating an analogy of geological structure applied to the migration of language. The order of evolution is that of the cephalic indices (75–86); but the migrations have been somewhat irregular, especially the Sanskrit Alpines (Lithuanians, etc.). Later the Slav tribes dominated the Sanskrit Alpines and were in turn overrun by the Altaic Magyars. Compare Figure 6.

The dominance of a language depends on a sort of mass effect. In Europe the Magyar and Finn have held their own, but no more, amid Aryan tongues. In China the converse occurs and the Lolo—of the Gaelic (?) horizon—have barely held their own among speeches allied to the Lapp and Magyar.

5. The most confusing condition arises when we have a transgression of speech somewhat resembling a transgression in stratigraphy. In this case a later language moves far across the earlier languages, not following in sequence but skipping many intermediate zones (see Fig. 8). An example occurs in Europe in the Alpine folk with a head index of 82–88. They arrived in Europe in Neolithic times, long before the Slavs (80–82) and probably before the Teutons (77–80). The important point to notice is that though they arrived first in Europe their speech was more advanced than that of the later comers.

6. It cannot be too strongly emphasized that the development of race and language of all the Aryans occurred in Asia during probably 100,000 years. Except perhaps in the case of the Gaelic tribes, more of their evolution has occurred in Turkestan or thereabouts than in their present abiding places to which many of them migrated only about 5,000 years ago.

7. The phenomenon of the shatter belt (see Fig. I, Pl. I and Fig. 2) has been discussed earlier. Just as there are lines of weakness in the crust along which earth movements take place era after era, so there are corridors

THE LAVA-FLOW ANALOGY

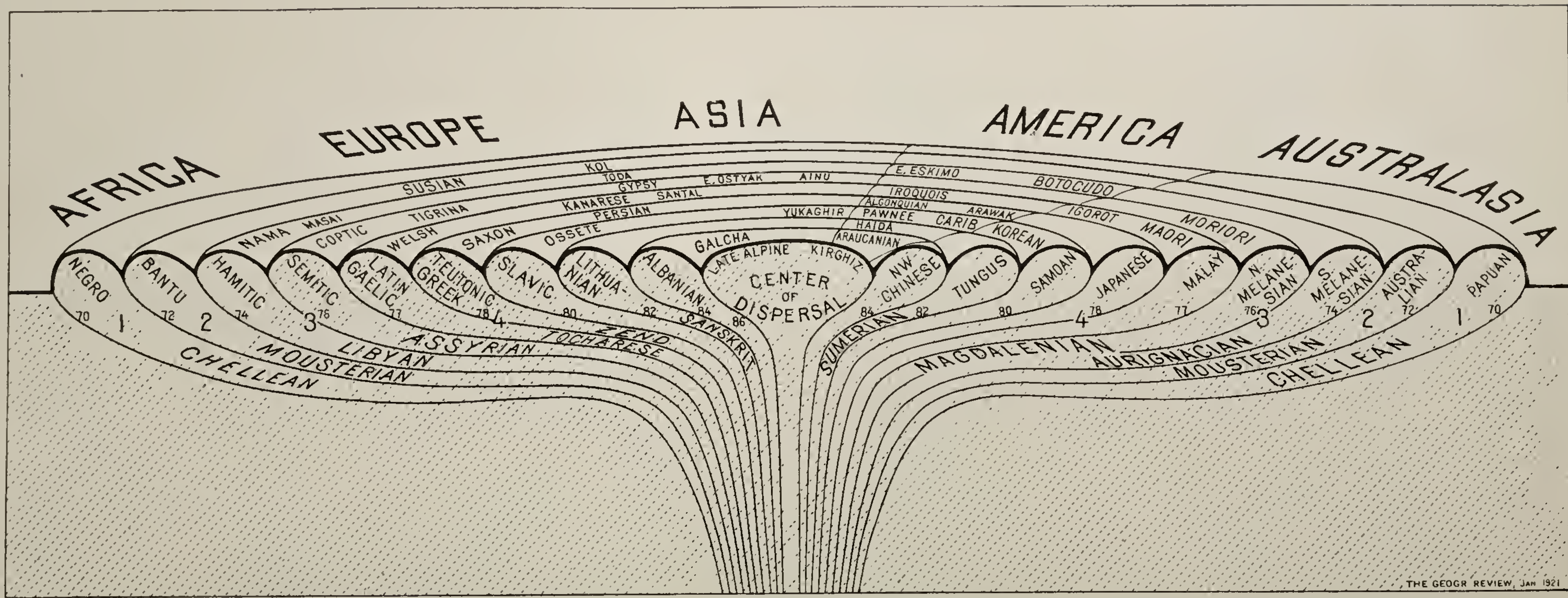

FIG. 9—The lava-flow analogy applied to studies of evolution and linguistics. The center of dispersal in Central Asia is pictured as a sort of "fissure eruption" sending forth streams of lava in all directions. Each new eruption arises from the center and, while covering some portion of the previous flow, pushes most of the previous lavas out to the periphery. Other analogies are represented in Figure 8. Fossil languages, buried under existing tongues, are seen in section. On the surface are shown existing languages typical of the several migration zones.

along which tribes migrate age after age. In both cases the margins are rent, pushed aside, and in part absorbed. This explains the conditions in the Caucasus and in California and Brazil, where the mosaic of dissimilar tribes flanking the great linguistic families are the débris fringing the main corridors of migration. I have no doubt that the shattered tribes in the Caucasus will ultimately be correlated with their Aryan (Pamir) or Turki (Altaic) congeners of the same cephalic index.

8. No language is at a standstill; but the isolated mountain or forest dialect—far removed from stimuli intellectual or otherwise—alters very little as compared with a civilized language. Nothing accelerates a language so rapidly as the development of writing. The three most advanced languages today are probably Chinese, Persian, and English. Of these English has developed most, for it differs in structure almost entirely from the synthetic inflected Anglo-Saxon and is now eminently analytic and uninflected. Persian has, I believe, undergone a similar change but has taken about twice the time. Chinese probably started with a higher (i.e. more concise and economical) language about 10,000 years ago and had advanced further than English about 5,000 years ago.

9. In all cases the study of evolution becomes much more simple if we ignore the developments of the last 500 years. Western Europe has had unique opportunities in her climate and in her resources. These, coupled with her choice of religion and philosophy, have given her the first place in the world, but it is too often assumed that race is the first factor and that religion is of equal importance, while environment is often ignored! The converse is nearer the truth; for, as we have seen, race *per se* has been only a small factor in the development of civilization.

The Lava-Flow Analogy

We may picture the center of dispersal in Central Asia as a sort of "fissure eruption" sending forth streams of lava in all directions. Each new eruption arises from the center and, while covering some portion of the previous flow, pushes most of the previous lavas out to the periphery. If we postulate that the early lavas still retain some mobility and occasionally flow across the later lavas, we get a very close analogy to what has happened in the migrations of man.

I have endeavored to show this in Figure 9. It explains fairly clearly the relations of the "fossil" to the "migrant" languages described above. On the extreme periphery we see the true Negro (70–72), who appears only in Africa and Papua. But we see that Chellean relics *under* the center of dispersal still bear witness that he once lived in all the intervening zone. The next zone is the Mousterian, found all round the periphery in southern Africa, southern Asia, southwestern America, and Australia. Then come the Hamitic, Iberian, and Semitic peoples who have a world-wide distribution as the culture maps have shown.

Here the dead languages begin to help us. We have relics of Iberian writings in many Neolithic scripts, such as those figured by Sergi[54] from the French dolmens and from Cyprus, Crete, and Libya. The Egyptian hieroglyphs are Hamitic and allied to the modern Coptic. By analogy they may be found to be still more like some outlying Hamitic *migrants* that have preserved the more primitive speech. Assyrian and Babylonian are well known from the clay tablets. Their closest affinities in the same way may well be not with modern Syrian but with some tribes pushed away from Assyria by migrations about 5,000 years ago and now living on the periphery of the Semitic zone, e.g. in Abyssinia.

The Linguistic Problem of the Indo-Aryan Races

When we come to the Aryan languages the problem becomes very interesting, for we know more of the philology of the various speeches. My conclusions differ considerably from the orthodox views which I have come across in all textbooks.[55]

The palladium of the philologist is Sanskrit; but it seems evident to me that Śanskrit was first spoken thousands of years after Gaelic, Welsh, Latin, and possibly Teutonic and Greek had come into existence (in the order named).

The characteristic of the earliest Aryan tongues is the prevalence of the *k* sound (often as *qu* or *kv* or *kw*). This appears in Gaelic *kuig* (five) and Latin *quinque*. It is replaced by *p* or later by *f* in Welsh, Greek, and Teutonic (*pump*, *pente*, *funf*). Now in the Assyrian inscriptions we find reference to the Tochari, and these peoples (who lived in Bactria) are found to belong to the *k* tribes.[56] We can therefore show Tocharese as a dead *k* language in our diagram (Fig. 9) connected to the outer zone of Gaelic and Latin. Now Sanskrit uses the word *panch* (five) as do the present-day Galcha tribes (Swat and Siah-Posh) of the Hindu Kush region. It also uses the later form of the word for hundred, i.e. *satem* for *kentum*. Lithuanian is in many ways close to Sanskrit, and its word is *penki* which is merely a form of *panch*. If we use our "touchstone"—the cephalic index—we find that the Galcha lie on the isokeph of 83–85, the Lithuanians are about 83, and we may infer that the speakers of Sanskrit were of the same brachycephalic type. They were much later than the Gaels (76), Welsh (78), or Teutons (79).

The Indo-Aryan races may be subdivided first into the well-known *kentum* and *satem* groups and then as in Table VII.

If this table is accepted—and it seems to agree both with modern philology and with the migration-zone theory—then several important results follow.

[54] G. Sergi: The Mediterranean Race: A Study of the Origin of European Peoples, London, 1901, pp. 288–305.

[55] Except perhaps portions of T. G. Tucker's invaluable "Introduction to the Natural History of Language" (London, 1908), which I have used considerably in contrasting the structure of languages.

[56] See Encyclopaedia Britannica, 11th edit., Cambridge, 1910, Vol. 14, p. 495.

It shows that there was an enormous transgression in Neolithic times, whereby a very advanced language spoken by Alpine peoples was brought right across the center of Europe. They had a less powerful organization than the Etruscan and Mycenean civilizations so that the peoples of the latter (helped by some Alpine blood) dominated, and their primitive *kentum* languages prevailed. But, when the Roman Empire gradually absorbed the Dacians, the Wends, the Swabians, the Belgae, and the Alpine Kelts, it did not impose Latin upon these peoples (as every classical

TABLE VII—RELATION OF CEPHALIC INDEX AND LINGUISTIC STRUCTURE

Group		Cephalic Index	Language	Five	Hundred
Kentum languages	*k* languages (v. five, etc.)	76?	(Tocharese)	?	?
		76	Gaelic	Kuig	Keud
		77	(Latin)	Quinq	Kentum
	p languages (v. five, etc.)	78?	(Oscan)	?	?
		78	Welsh	Pump	Kant
		78	Teuton	Fimf-Pimp	Hund
		79	Greek	Pente	(He) katon
Satem languages	Early Alpine	80	Persian	Panch	
		81	Slavonic	Pietz	Sito
	Later Alpine	82	Lithuanian	Penke	Szimta
		83?	(Sanskrit)	Panch	Satem
		84	Galcha	Panch	
		85	Armenian	Pese	

history seems to infer).[57] These barbarians had much higher languages of their own and very sensibly stuck to them. Their languages, for reasons stated, differed very little from Sanskrit, so that they readily adopted some of the Latin speech and syntax. It is most suggestive that the five languages which postfix the article are Lithuanian (82), Rumanian (82), Bulgarian (82), Albanian (83–85), and Old Norse. In the latter a small outlier of index 83 occurs (see map Fig. 6).[58]

In no other way can one account for the fact that the European Alpine peoples, though ethnologically homogeneous, have so readily taken to French or German or Italian or Rumanian or Slav. They all originally spoke something akin to Albanian or Ladin, a sort of improved Aryan tongue (like Sanskrit), to which Latin, Teuton, and Slav were slowly evolving. They met the lowland invader halfway, as it were.

[57] Tucker (*op. cit.*, p. 241) is much more frank and writes "We can only guess at the original language of stock B" [i.e. Neolithic Alpines (83–88)].

[58] Linguistic data from B. G. Latham: Elements of Comparative Philology, London, 1862, p. 625.

This may help to explain why all the cumbrous suffixes of Latin vanished so rapidly, while the roots (common to Latin and Alpine tongues) passed almost unchanged into the Romance languages. I am unable to find many data regarding the type Alpine languages in Europe (Ladin and Albanian), but Albanian is always classed as a *satem* speech (see Table VII).

The real connection between ethnology and language has, I trust, been brought out as regards the great Aryan group of languages. This is not the place to discuss phonetics, but I have no doubt that Grimm's law of phonetic change will be found to be related in no small degree to the climatic changes to which the tribes were subjected. These climatic changes were not only those inherent on their wanderings but were also secular and affected stationary peoples as well. In the 100,000 years occupied in the variation of the Aryan languages there were, in my opinion, four considerable secular changes of climate; and the tribes themselves marched from arid Central Asia to cold wet Norway, so that the climatic stimulus varied greatly and was undoubtedly very important. I hope to develop this in a later paper.

Space does not permit of adequate treatment of the other great linguistic families, the Negro, Bantu, Dravidian, Hamitic, Melanesian, Iberian, Semitic, Malayo-Polynesian, Ugrian, Tungus, and Chinese, not to mention the horribly complicated tangle in North and South America. But it seems logical to me that the principles I have applied to the Aryan group cannot fail to help comparative philology in other continents. I propose to summarize the evidence which I have collected in the hope that later the problems may be undertaken in detail.

Table VIII shows in a highly generalized fashion some of the main concepts in this paper. The cephalic index is correlated with the languages and customs of type races in the four continents. The customs have been correlated previously, but the languages, especially of America, are merely inserted to help further study. I feel sure that some such seriation is legitimate, but the evidence to date is admittedly slender.

The Most Primitive Languages

We may rapidly run through the series of languages in the region between South Africa and China. The most primitive languages are probably those of the Sudanese Negroes, allied to Wolof, etc. This group extends across Africa to Abyssinia, where there is a typical shatter belt of all sorts of languages. The languages are not capable of expressing delicate shades of meaning, and there are no genders, etc. Curiously enough their very primitiveness makes them in some ways resemble Chinese, English, and other highly evolved languages. In former German East Africa the Mbugu are a Sudanese group, where primitive inflection is just beginning to approximate the language to Bantu.[59]

[59] Alice Werner, transl.: An Introduction to the Study of African Languages, by Carl Meinhof, London, 1915

TABLE VIII—EVOLUTION OF CULTURE AND LANGUAGE (TENTATIVE CORRELATION)

Group	Migration Zone and Cephalic Index	Language Type	Typical Customs, Folklore, etc.	Africa, Europe	Asia	America (Suggested only)	Australasia
I	Negro (70–72)	Jejune; often reduplicating; absence of gender; few numerals	Fetishism	Sudan and Guinea tribes Mbugu			Papuan
II	Mousterian (72–74)	Very complex prefixes and suffixes; much alliteration	Fetishism matriarchy; group marriage; boomerang; totemism	Bantu	Nair, etc.	Botocudo?	Australian New Hebridesan
III	Hamitic (74–75)	Polysynthesis common; and more regular synthesis	Couvade; totemism; serpent cult	Masai Fulah Basque	Dravidian	Eskimo Iroquois	Dentrecasteaux
	Semitic (75–76)	Triliterals	Couvade; serpent cult	Coptic Tigrina	Arabic Hebrew (Kanarese)	(Algonquian)	South Solomon
IV	Early Aryan (76–78)	Highly synthetic (*kentum* in west of Eurasia)	Monoliths; Gaelic belt; tattooing; levirate	Gaelic, Latin } *k* Greek, Teuton } *p*	Igorot Japanese Korean	Algonquian Arawak Athapascan	Malay S. E. Papuan Maori
	Late Aryan (78–80)	Highly synthetic to analytic (*satem* in west of Eurasia)	Unforked kin words; levirate; shamans; swan-maiden myths	Slavonic	Persian Galcha	Carib Tlingit Haida	Louisiade E. Solomons
	Early Alpine (80–85)	Vowel harmony; clear suffixes to root; losing inflections	Forked kin words; head deformation; shamans	Magyar Serb Czech	Finn Tungus	Shoshone Aztec? Sioux?	Hawaiian Samoan Tahitian
	Late Alpine and Mongolian (85–88)			Albanian	Kirghiz	Quichua?	
		Tending to positional; monosyllabic	Early triumph of art and social law		Chinese		

The Groups I–IV are related to the Four Great Ice Ages.

THE "MOUSTERIAN" LANGUAGES

The next great family may be called the Mousterian. It includes the Bantu, a few low tribes in India (Nair?), and the Australian. By this time inflection is in full swing. In Bantu (74) prefixing usually prevails, and we shall note a gradual change as we ascend the scale. Thus in Semitic (76) we find prefixing and postfixing about equally developed. In Aryan

(79) inflections are mostly postfixed. In Ural Altaic (83) the affixes are always postfixed.[60] Australian is higher in type, for may tribes have three numbers (including dual). The inflections are usually suffixed and are extremely numerous and complicated. Thus the noun expresses time also. Genders are not usually shown by inflection.[61] I have no data of the cognate Indian tribes.

Hamitic and Iberian Languages

The next zone includes the Hamitic tribes, who are well represented in the Sudan, in the Deccan, and probably along the eastern coast of America. They have developed along somewhat different lines in these three widely separated regions. In Africa the most primitive type is the Hottentot Nama, who is an "outlier" of relatively high head index (75) amid lower Bantu. It preserves the primitive dual number, like the Bantu, but has the general character of the Hamitic tribes. These have full inflections for number and gender. The feminine (or weaker) gender is marked by *t*, which also characterizes many Semitic languages. There is no doubt now that Semitic has been derived from Hamitic.

Basque is spoken by a very mixed set of peoples in the Pyrenees. The majority have a head index about 79, but a few Cevenole (84) villages are also included. The language seems to be more nearly allied to Berber (Hamitic, 76) than to any other, and the nucleus of the Basque country has folk of this head index. Is it possible that we have an isolated Etruscan colony here, like the corresponding one in Nigeria, which once dominated a much larger region? The Basque language is therefore a fine example of a retrogression in that the speech of a lower race has conquered that of a higher. We get the same thing in the interior of Victoria, where you may hear a veritable pure-blood Chinaman asking for his "pyper" (i.e. newspaper) in typical Australian vernacular! Basque is of course the sole European language (with possible exception in the Caucasus) which incorporates the object in the verb. This is very characteristic of the American languages. Basque takes in the direct pronominal object (and French has a touch of this also). Iroquois can also incorporate the noun object in the verb and "has nothing in common with the structure of the Algonquian or Sioux languages"[62] adjoining. This can only mean that it belongs to a different migration zone, as I postulated from the head form (76 or so) in my previous paper. No error has been so widely promulgated as that all American languages are polysynthetic and incorporating. The best-known tribes were the eastern *primitive* tribes, just as in Eurasia the best-known were the western *primitive* tribes. One incorrect, if natural, result of this has been to place the Teutonic speech on a pinnacle which it by no

[60] Henry Sweet: The History of Language, London and New York, 1900. The figures are cephalic indices, which I have added.

[61] Roth: West Queensland Aborigines, 1897. (Pitta Pitta tribe.)

[62] Franz Boas: Anthropology of Canada, 1910, p. 530.

means deserves and to degrade the Amerind languages to the level of the (Hamitic) Iroquois, which is almost the lowest in the continent! Such are some of the results of the neglect of a geographical treatment of linguistics.

Semitic Languages and Their Relation With Aryan

The next great group which we meet in our traverse is the Semitic. This is best known from Hebrew and Arabic. It is somewhat sharply

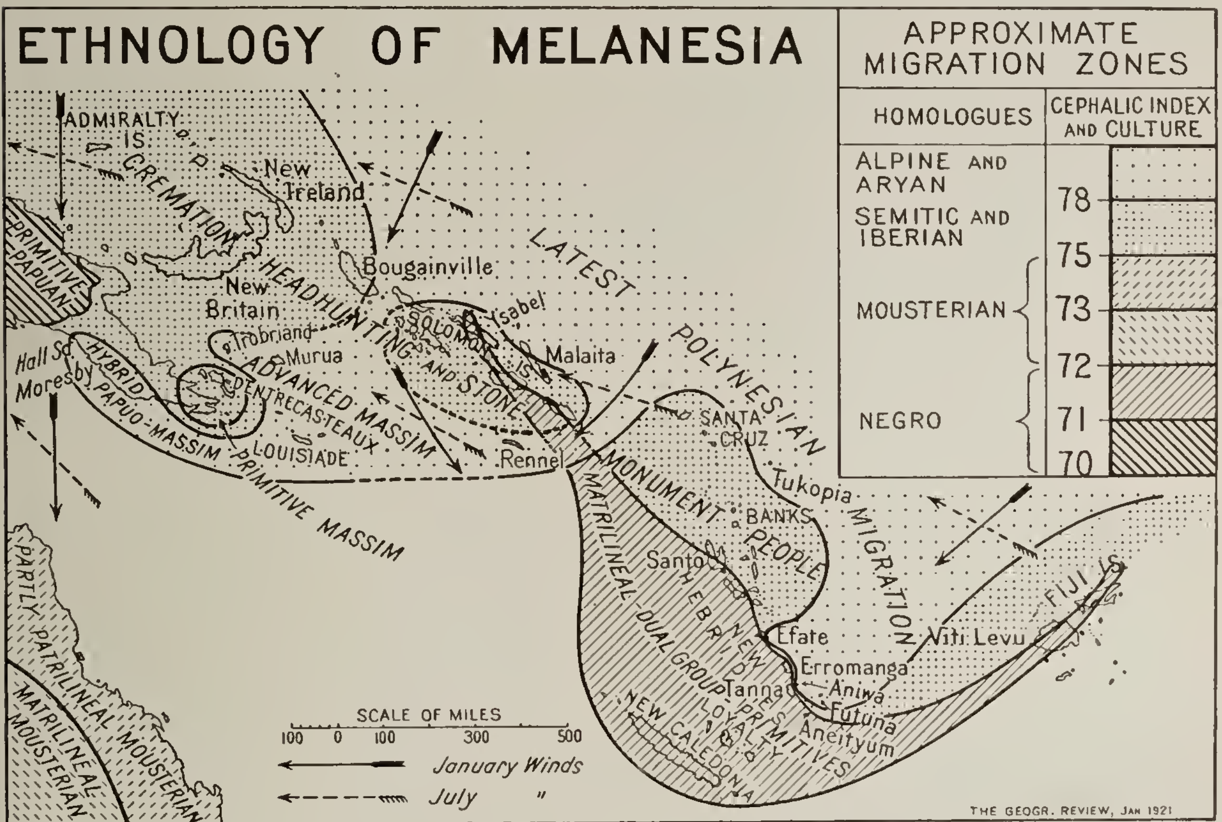

Fig. 10—Map showing the ethnology of Melanesia (based in part on Rivers, Seligman, and Codrington). The migration zones merge somewhat, especially in the north. The Polynesian migration from the east has cut across the earlier Iberian and Negro migrations.

marked off by the triliteral words which build up much of the language. Thus *falat* (bend) is changed into *filat*, *fulatu*, *falu*, etc., much as we add inflections. Macdonald has shown that this scheme is quite usual in languages of Melanesia,[63] in fact just where the Black Jews mentioned previously are found. He shows also many similar roots connecting Efatese (Melanesian) with Arabic and Malay and of course also with Polynesian.

I have no doubt whatever that the clue to the connection between Hamitic, Semitic, Aryan, and Alpine languages will be found in the numberless dialects extending from Aneiteum (New Hebrides) to New Britain and to Samoa. Here each group of islands is occupied by a wave in the migration zone, and we can trace the evolution of head form from 74 to 83 and the corresponding change in language more clearly than anywhere else in the world.

[63] D. Macdonald: The Oceanic Languages, London, 1907.

Macdonald believes that the Melanesians came straight from Arabia, but they are of course primitive tribes pushed out of Burma and Malaysia by the great Aryan and Mongolian migrations. The Tagala language in the Philippines has Semitic affinities, e.g. it modifies a word even more peculiarly than does the Semitic ablaut. Thus the triliteral *sulat* becomes *s* (*in*) *ulat* (*an*).

Judging by analogy some of the Algonquian tribes should show Semitic features. No doubt the old stories of the Lost Ten Tribes and of Hebrew words in America will have some slight foundation in this respect. If the Haida-Tlingit (80) group has affinities with Melanesian, as Boas suggests, it is most probably with the northern Melanesians, who have a head index about 79 (e.g. in New Britain), and not with the Black Jews of the Solomons.

The connection between Semitic and Aryan in the Eurasian region is very vague, probably because the Assyrian and allied dialects were highly altered from their primitive condition. No doubt primitive Semitic dialects (perhaps from Abyssinia) will show a relation to primitive Aryan, e.g. Gaelic or some Deccan dialects.

Aryan Languages Outside Europe

The Aryan group has been treated fairly fully for the European section. The connection with the lower Indian dialects (e.g. Kanarese, 76) is quite readily distinguished. I have no doubt that the Lolo peoples (who wear garments like those of the Bretons and other primitive Aryans) speak an Aryan language.[64] There are many features in Maori (79)[65] which remind one of modern English, for instance the articles, the uninflected noun, the feeble development of gender, the prepositions, and their relation to article and noun. Other features however are unlike. Japanese to some extent seems of a primitive Aryan type. It has independent pronouns but with clumsy forms still showing their origin (e.g. "I" is translated by an abbreviation of "selfishness"). It has noun suffixes, which are however to some extent separable and show their etymology also. It is of course not even remotely connected with Chinese (though it derives hundreds of words from the latter) but has many affinities with Malay and Polynesian.[66]

In North America many of the Plains Indians speak languages remotely resembling Aryan, e.g. Pawnee (85) bears resemblances to Sanskrit (83). Athapascan (83–78) does not incorporate readily, and the object is independent. It is most interesting to note how the small units on the western coast (in the shatter belt) agree with the less disturbed tribes on the other side of the Great Corridor. Thus we may compare the sections using

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[64] Described as monosyllabic. See A. F. Legendre: Far West Chinois, *T'Oung Pao*, Series 2, Vol. 10, 1909, pp. 340–380, 399–444, 603–665; reference on p. 635.—Edit. Note.

[65] The lower Polynesians resemble the Greeks and Persians in their substitution of H and S. Grimm's Law connecting P and B, T and D also holds for Polynesians as for Germans (Tucker, *op. cit.*, p. 237).

[66] "Polynesian could never be classed as agglutinative, inasmuch as it expresses grammatical relations by free particles after the manner of the most advanced analytical tongues such as English" (Tucker, *op. cit.*, p. 141).

Athapascan speech—two small groups on the western coast and two much larger groups on the eastern side of the (later) Shoshone and Navajo nations. Salishan Chinook are probably not far removed in kin from some Athapascan tribes; but there has been a great transgression of the Athapascan dialect, as I have suggested earlier, and details are too few for me to do more than suggest their ethnic and linguistic affinities (see Fig. 2).

As regards the Alpine and Mongolian peoples we may consider for a moment their distribution in Asia. The Alpine folk of the southwest, Galchas, Armenians, etc., were undoubtedly once in contact with the great Alpine group of central Europe. They spoke an Aryan tongue. But the tribes to the northeast of these, e.g. the Kirghiz, Yakuts, etc., though of somewhat the same head form, were presumably isolated from the Galchas, etc., by the marshes and deserts of the country about the Aral sea. Hence their languages are not particularly similar, though as usual the most primitive representative, Finnish (81–83), is readily compared with Slavonic (81–83).

The Finns, Magyars, Turks, and Tatars entered Europe from the northeast, the other European Alpine peoples came from the southeast; hence the distinction (see Fig. I, Pl. I). The isolated position of the Yenisei Ostyaks has often been remarked. Their language is akin to none near by, nor is their head shape (76). Probably Ainu is a congener.

The great group of Paleo-Siberian folk in the northeast of Siberia (Chukchi, Koryak, Yukaghir, 82) have been found to agree linguistically very closely with the similar zone in Alaska and Canada. I do not see why it is necessary to assume that the Yukaghir originated in America, as some ethnologists aver. This would be contrary to all the other evidence of migrations. For the same reason we must assume that the Eskimos are of Asiatic and not European origin. The pure tribes are, as always, found furthest from Asia, i.e. in Greenland. Here they are shorter and less Mongolian, in fact true Aurignacians. The Western Eskimos are obviously a mixed people.

It does not seem to be realized by Americans how diverse are the various Melanesian peoples. (The writer no doubt makes similar false analogies with regard to Amerinds.) For instance the Salishan speech is described as more like Oceanic than Algonquian. I can quite believe it, but "Oceanic" ranges from "Hamitic" up to "Alpine." Furthermore, some of the old analogies, which are almost forgotten today, seem well worthy of revision. Thus Petitot compares Algonquian with Celtic, Mendoza relates Nahuatl to Aryan, and Hamy says Otomi is isolating and monosyllabic like Chinese.[67] In many respects these seem to the writer very logical comparisons, though he cannot refer to the original papers.

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[67] Quoted by A. F. Chamberlain: The Problems of the Unity or Plurality and the Probable Place of Origin of the American Aborigines: The Problem from the Standpoint of Linguistics, *Amer. Anthropologist*, Vol. 14, (N. S.), 1912, pp. 50–57. [It should be stated that Chamberlain regards all such comparisons as "unjustifiable."]

As regards South America, I cannot get any data of value. There is little doubt of a general evolution from the Ges speech of the Botocudo (74) up to the concise highly-developed speech of the Araucanian (86).[68] The same phenomena of corridors, shatter belts, outliers, inliers, and transgressions are obvious, but it is not possible for an Australian to cope with them. One main reason is because the Americans seem to have abandoned the cephalic index as one of the mainstays of ethnology; and even Wissler's most valuable textbook gives very few coefficients beyond those I have used so continuously from Deniker. I trust that this paper, if it does nothing else, will show how helpful is this old-fashioned criterion and will lead to renewed activity in measuring the aboriginals who are everywhere vanishing before the so-called "white civilization."

One last word as to the highest type of speech. Ethnic data are wanting for Central Asia. The Chinese of the coasts are put down at about 85, but the purest and last developed Chinese will be found in the northwest. Here it is quite probable that they rise to 88. Thus we have two groups of peoples, the Alpines and the Neo-Chinese, included within the 86 isocephalic line. They have never mingled to any degree, for the topographic conditions have been adverse. Bleak steppes to the north, a huge arid plateau in the center, and the Himalayas to the south have kept them independent for 50,000 years, except perhaps for some contact in Persia and the Tarim region. The Alpine folk have never produced a purely Alpine civilization, though the whole of European progress since the Achean invasion of B. C. 1000 has been leavened by their sterling virtues. But, owing to a variety of factors, Etruscan civilization (76) has been followed by Roman (76-77), and this by Spanish (77) and British (78). The Carlovingian and Hapsburg dominations were, I suppose, Alpine. Possibly the whole matter turns on command of the sea, for the European Alpines have never been coastal peoples except in Dalmatia. Today the most highly evolved crania of the West belong to the Swiss and the Albanians. Who shall say how far they might go, should militarism be scotched and the small nations be able to give themselves freely to the arts?

Chinese Compared With Modern English

Of the Chinese I have written much already. Their language was undoubtedly a thousand years ahead of any other at the dawn of history. Why has it not progressed? I am inclined to think that this is due chiefly to two factors. Their philosophy was eminently conservative, so that everything must be sanctioned by custom. This method of everlastingly "looking backward" for precept and guidance kills all progress. Moreover they were remarkably free from competition with any other nation. No doubt they were often at war but always with barbarians. They lived in a sort of

[68] The same structure of the verb is found in Araucanian and Turkish (Tucker, *op. cit.*, p. 87). It is significant that these races are on the same isokeph (84-86), and probably both originated in southern Siberia about the same time.

"Yellow China," and all history shows that nothing can be so harmful to a nation, if this policy be carried too far.

Modern Chinese, like modern English, consists largely of "small square strong root words" far superior to the inconvenient flexion-encumbered Indo-Germanic sentence word.[69] It has an abundance of auxiliary words just as we have in English. It makes great use of *position* as a clue to the meaning of a sentence and in fact uses much the same word order as we do. There are practically no inflections.

If we study outlying allied languages such as Tibetan we can trace the development of Chinese from something akin to Manchu to its present form. It is false to say that Chinese is one of the most primitive and jejune of languages. Possibly it is not very flexible, but I am inclined to believe that the spoken language is superior to the written in this respect. If the Chinese people could only drop the archaic pictographs, or ideographs, of which 3,000 must be remembered (in place of our 26 letters) I can imagine that Chinese would take rank with English as a world language. It is indeed gratifying that the English speech has developed within a short 1,500 years from the archaic Anglo-Saxon to one of the best means of expression. Let us pray for the time when the orthography shall be worthy of such a noble language so that the spelling may be fitted to the spoken word and not preserved merely to simplify the labors of etymologists!

Conclusion

If my views are correct, it is obvious that many current opinions with regard to the mixing of nations are not supported by ethnology. It is most unfortunate that the half-caste problem has aroused most attention in the United States and in India, and that all our ideas are inevitably colored by results in those regions. The African Negro is the least evolved of the races of man, and ethnically the white negro half-caste is lower than the white. Possibly there may be something in the idea that the cranial sutures close too soon in the case of the Negro to admit of full expansion of the brain. In most of India the tribes are of a lower ethnic type than the European. Even in the north the so-called Aryan tribes are largely pre-Aryan (below 76), though with the Aryan speech. Hence here also the Eurasian may very well be below the white standard, unless the most advanced Indians are involved. I am disposed to think, however, that in many cases the ethnic deterioration is too slight to be important and that racial antipathy rather than racial degeneration is largely to blame for the troubles of the Eurasians.

As regards the Alpine, Mongolian, and most Amerind and Polynesian peoples the future seems to me to be most promising. It is our diseases and our vices, especially the use of alcohol, which constitute the so-called "overpowering effect of the white civilization" upon the uncivilized nations.

[69] J. O. H. Jespersen: Progress in Language, New York, 1894, p. 127. See also Tucker, *op. cit.*, p. 125.

When they are protected from these evils, and when public opinion is educated to regard them as our ethnic equals instead of as our inferiors, we may hope to see them thriving equally with the European nations. In South America, as Bryce has pointed out, the *mestizo* is quite equal to the pure Spanish peasant. He may well be so, for the Spanish Iberian is in many cases raised in the ethnic scale by the mixture with Aryan or Alpine blood which fills the veins of so many Amerinds. The same results may be expected with regard to most Mongolians, with the possible exception of the southeastern tribes of Asia, where, it may be, there is a large proportion of lower Aurignacian stock.

Appendix

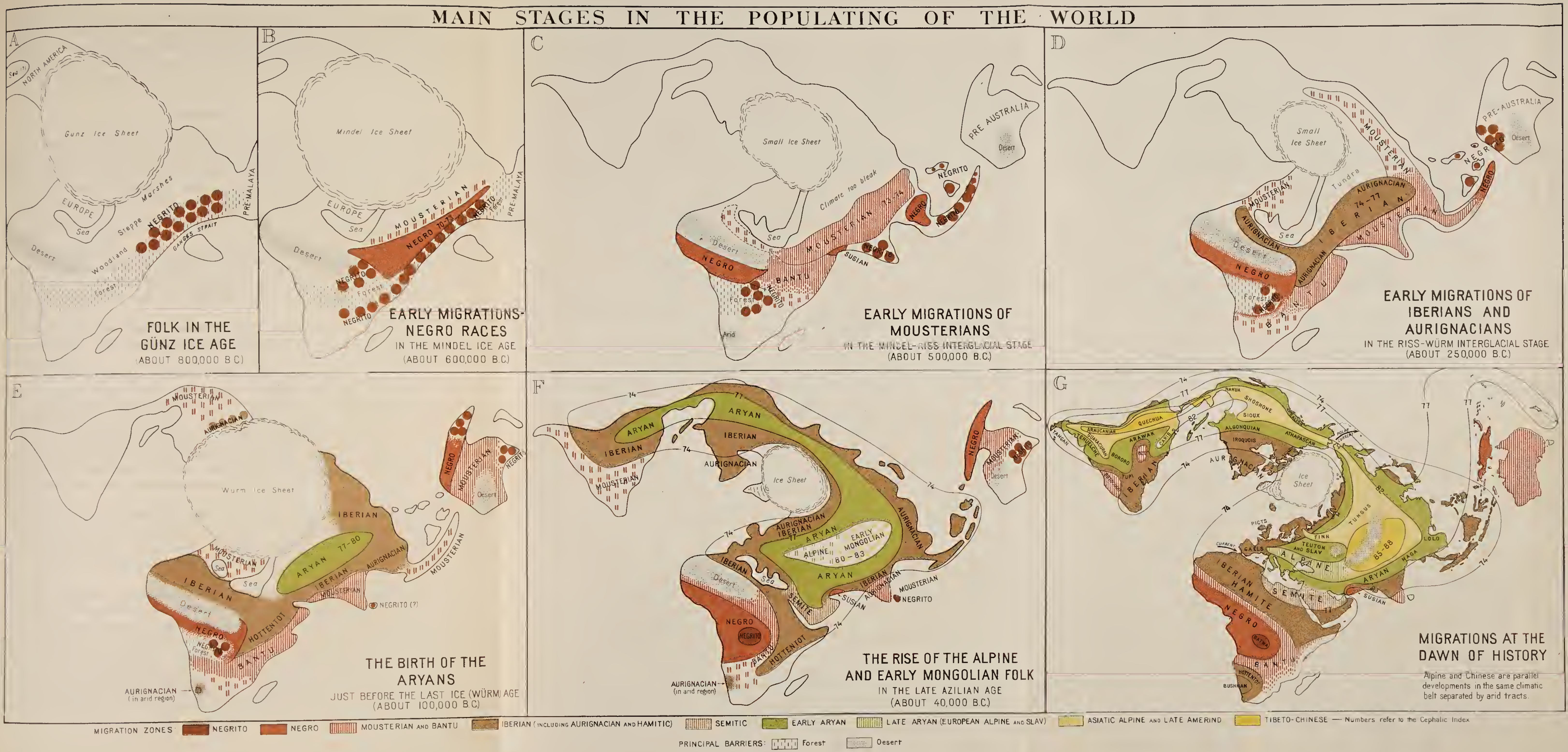
The Climatic Cycles

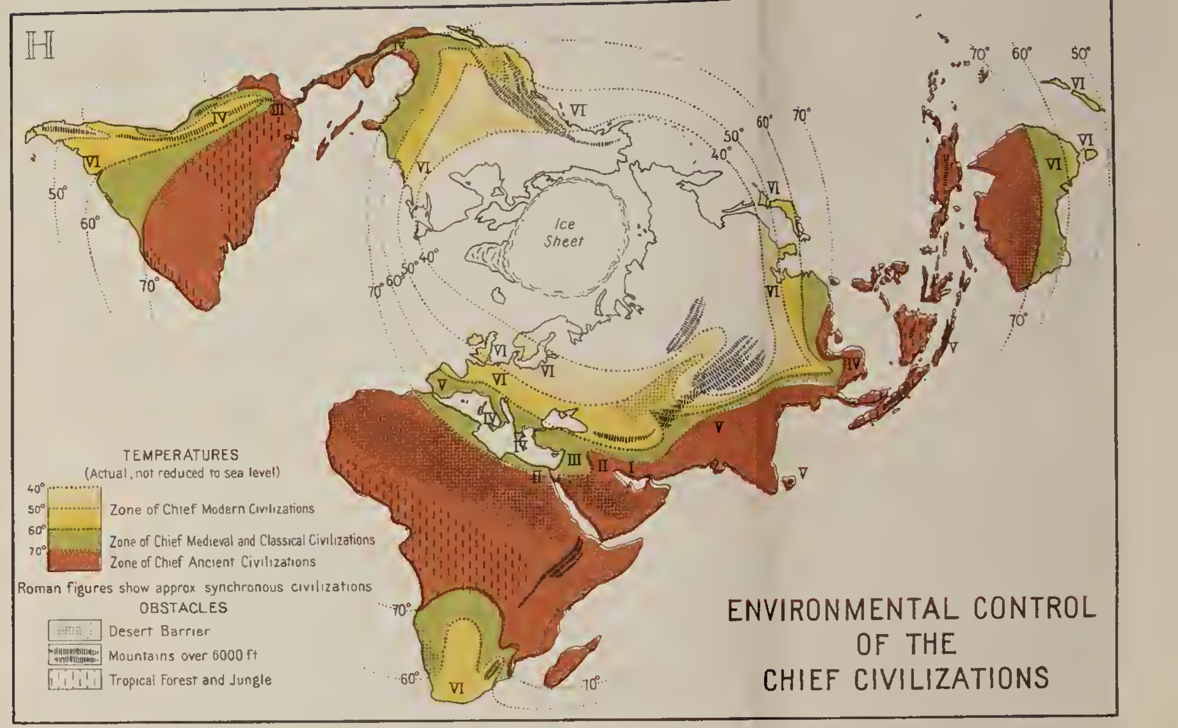
In my former paper I expressed my belief that the Ice Ages occurred at intervals of about 200,000 years, and I suggested as possible causes planetary or stellar disturbance. Only recently have I learnt that G. H. Darwin had suggested a cycle of 200,000 years on the variations of the orbit of the earth.[70] Croll's similar work did not appeal to me, for his cycles recurred every 21,000 years, which is certainly not the case with the Ice Ages. It is, however, quite possible that his short cycles accounted for minor migrations.

If now the shape of the earth's orbit changes from nearly circular to relatively elliptical, we shall get the change from *uniform* climates to *zonal* climates which I described fully before. This change in orbit is, I understand, supposed to be largely due to Venus and other planets in our solar system; and Darwin's suggestion certainly encourages me to believe that some such agency is operative in determining my minor cycles. Why, however, do not the Ice Ages recur *every* 200,000 years? Why does the earth enjoy a uniform climate for nearly 100,000,000 years before the next set of Ice Ages as postulated in my *major* cycles?

It seems probable that at each *major cycle* the earth is subjected to two different forces. (1) The orbit becomes very elliptical with the results given above. (2) The earth's crust is subjected to great strains so that buckling and cracking occur and the mountain systems are redeveloped from old peneplains. We know that precession is due to a differential pull by the moon and sun on the equatorial bulge. Is it not possible that some unknown stellar body can affect our solar system each 100,000,000 years so as to cause much greater strains on the crust at the earth's equatorial bulge? I am aware that it seems difficult to imagine the earth being so affected without considerable derangement of the planetary orbits. Since, however, the earth can change its orbit, as astronomers admit, this may not be an insuperable objection.

[70] Cited in H. G. Wells: The Outline of History, 2 vols., London and New York, 1920; reference in Vol. 1, p. 20. I have not been able to verify the original statement.


MAIN STAGES IN THE POPULATING OF THE WORLD
A
FOLK IN THE GÜNZ ICE AGE
(ABOUT 800,000 B.C.)
Günz Ice Sheet
NORTH AMERICA
EUROPE
Sea
Desert
Steppe
Marshes
Woodland
Forest
NEGRITO
PRE-MALAYA
GANGES STRAIT
B
EARLY MIGRATIONS-NEGRO RACES
IN THE MINDEL ICE AGE
(ABOUT 600,000 B.C.)
Mindel Ice Sheet
EUROPE
Sea
Desert
Forest
MOUSTERIAN
NEGRO
NEGRITO
PRE-MALAYA
C
EARLY MIGRATIONS OF MOUSTERIANS
IN THE MINDEL-RISS INTERGLACIAL STAGE
(ABOUT 500,000 B.C.)
Small Ice Sheet
Climate too bleak
Sea
Desert
NEGRO
BANTU
MOUSTERIAN
SUSIAN
NEGRITO
PRE-AUSTRALIA
Desert
Forest
Arid
D
EARLY MIGRATIONS OF IBERIANS AND AURIGNACIANS
IN THE RISS-WÜRM INTERGLACIAL STAGE
(ABOUT 250,000 B.C.)
Small Ice Sheet
Tundra
MOUSTERIAN
AURIGNACIAN
IBERIAN
74-77
NEGRO
BANTU
PRE-AUSTRALIA
Desert
E
THE BIRTH OF THE ARYANS
JUST BEFORE THE LAST ICE (WÜRM) AGE
(ABOUT 100,000 B.C.)
Würm Ice Sheet
MOUSTERIAN
AURIGNACIAN
IBERIAN
ARYAN 77-80
Sea
Desert
NEGRO
HOTTENTOT
BANTU
NEGRITO (?)
AURIGNACIAN (in arid region)
Desert
F
THE RISE OF THE ALPINE AND EARLY MONGOLIAN FOLK
IN THE LATE AZILIAN AGE
(ABOUT 40,000 B.C.)
ARYAN
IBERIAN
AURIGNACIAN
Ice Sheet
EARLY MONGOLIAN
ALPINE 80-83
SEMITE
SUSIAN
MOUSTERIAN
NEGRITO
NEGRO
HOTTENTOT
BANTU
AURIGNACIAN (in arid region)
Desert
G
MIGRATIONS AT THE DAWN OF HISTORY
Alpine and Chinese are parallel developments in the same climatic belt separated by arid tracts.
QUECHUA
ARAWAK
SIOUX
ALGONQUIAN
IROQUOIS
ATHAPASCAN
SHOSHONE
Ice Sheet
PICTS
GAELS
TEUTON AND SLAV
FINN
TURKS
ALPINE
ARYAN
SEMITE
IBERIAN
HAMITE
NEGRO
BANTU
BUSHMAN
SUSIAN
LOLO
85-88
MIGRATION ZONES: NEGRITO; NEGRO; MOUSTERIAN AND BANTU; IBERIAN (INCLUDING AURIGNACIAN AND HAMITIC); SEMITIC; EARLY ARYAN; LATE ARYAN (EUROPEAN ALPINE AND SLAV); ASIATIC ALPINE AND LATE AMERIND; TIBETO-CHINESE — Numbers refer to the Cephalic Index
PRINCIPAL BARRIERS: Forest; Desert


H
ENVIRONMENTAL CONTROL OF THE CHIEF CIVILIZATIONS
Ice Sheet
TEMPERATURES
(Actual, not reduced to sea level)
Zone of Chief Modern Civilizations
Zone of Chief Medieval and Classical Civilizations
Zone of Chief Ancient Civilizations
Roman figures show approx. synchronous civilizations
OBSTACLES
Desert Barrier
Mountains over 5000 ft
Tropical Forest and Jungle


I
CLASSIFICATION OF THE WORLD'S CHIEF LANGUAGES
Ice Sheet
SIOUAN
ALGONQUIAN
ATHAPASCAN
ESKIMO
POLYNESIAN
MICRONESIAN
JAPANESE
AINU
MANCHU
MONGOLIAN
CHINESE
TIBETAN
SLAV
ALPINE
PERSIAN
SEMITIC
HAMITIC
NEGRO
BANTU
BUSHMAN
SHATTER BELTS
TIBETO-CHINESE
ASIATIC ALPINE LATE AMERIND
LATE ARYAN (EUROPEAN ALPINE, SLAV)
EARLY ARYAN
SEMITIC
IBERIAN (INCLUDING AURIGNACIAN) HAMITIC
MOUSTERIAN BANTU
NEGRO
NEGRITO

Finally, I should like to draw attention to the interesting diagrams in Huntington's "World Power and Evolution." Here (in Chapter VII) a cycle of climatic changes (cold wet, dry arid, warm moist) has been graphed. This is the same as I had deduced by another method, quite independently, though at a later date.

Summary

1. Attention is drawn to the value of the cephalic index as corroborated by the research of Macalister and Venn. Both the infantile and primitive skulls are relatively long (dolichocephalic), and in both there is a gradual change (racial and individual) towards brachycephaly.

2. The relation of color to head form and temperature is investigated. The sequence yellow, olive-brown, dark brown, chocolate occurs fairly regularly in zones around Tibet.

3. The present is an age of great geological evolution. Evidence based on the chief earthquake zones and on the distribution of terrigenous deposits in the Pacific shows that the coastal plains around the latter have sunk during the Pleistocene and so destroyed many of the chief migration corridors.

4. Data as to the Negrito seem to show that nowhere is the pure type preserved. The more primitive Negritos are progressively more dolichocephalic.

5. Seven charts are given showing the migrations of the various races from Asia during the Four Ice Ages and Interglacials. Thus in the Mindel Age, Negrito, Negro and Mousterian are migrating. In the Riss-Würm Interglacial the Iberians are developing in Asia, and in the Würm age the Aryans. The Azilian is marked by tremendous hordes of Iberians and Aryans entering America. The corridors of Gibraltar and Bering broke through about this time. The last chart shows conditions much as they were before the great modern migrations of European races to other continents.

6. Certain regions containing débris of many diverse tribes are called "shatter belts." They occur along the outside of the main corridor from Asia to America, in the Caucasus, in Abyssinia, and in Brazil. Their relations to the less disturbed tribes on the opposite side of the corridor are discussed.

7. The evolution of culture is dealt with in each zone. The curious parallelism of race distribution in Africa and in Australasia indicates that the peoples must have originated to the north of, and midway between, the two continents (i.e. in Central Asia).

8. The Mousterian culture, including totemism, the bull-roarer and the boomerang, is characteristic of the most primitive zone with head index 72–74. Similarly the Hamitic zone (74–76) is sharply defined as the couvade horizon in ethnology. The serpent and sun cults are of this zone also.

9. Reasons are given for allying the Semitic peoples with the earlier Hamitic races rather than with the succeeding Aryan races. Linguistic studies support this theory.

10. The Nordic races at the base of the Aryan (76–77) are marked by the monolithic monuments, and by the custom of tattooing. The Gaelic belt is well defined from Scotland to the New Hebrides. The folklore (such as the deluge and swan-maiden stories) forms a well-marked horizon.

11. The racial components of the European nations are tabulated. The French, Italian, and Grecian nations are shown to be as diversely constituted as the lately dismembered Austrian Empire.

12. Some success is obtained in disentangling the invasions of Europe by brachycephalic Alpines in Neolithic times. These preceded many dolichocephalic Teutons and all the Slavs, though these latter had originated first in the Turkestan region.

13. Levirate, head deformation, marriage by capture or purchase are discussed as regards "zoning" of the later Alpine and Mongolian races. The high status of the Chinese at the dawn of history is described, but it seems possible that the southern Chinese have incorporated many early Aurignacian tribes.

14. The rise of the various great civilizations is discussed in terms of environment and head form. The former is shown to be the controlling factor, and race has little to do with it provided the cephalic index be above 76. In almost all cases there has been a marked climatic deterioration in the regions famed for ancient civilizations. On the whole, races of medium head form have become dominant. The belts of civilization, like the isotherms, have moved poleward during the historic period.

15. If the languages comprised in a family be examined it will be found that the most primitive is spoken by tribes with the lowest head form, whose habitat in general is farthest from Central Asia. Thus Gaelic (76) and Latin (77) are more primitive than Welsh (77) or Teutonic (78) or Greek (78). All these are less evolved than Slav (81), Lithuanian (82), or Sanskrit. (Cephalic indices slightly smoothed.)

16. Many languages are preserved in three forms: fossil (like Sanskrit), highland "inliers" (like Galcha) or migrant (like Lithuanian). These concepts are described in terms used in geology, e.g. outliers, inliers, transgressions, shatter belts, etc., with considerable advantage.

17. The evolution of the various languages is graphically depicted like a series of lava flows emanating successively from a common center (Turkestan, etc.). Thus Bantu precedes and is thrust away by Hamitic, which is displaced in turn by Semitic (and then follow Aryan, Alpine, etc.).

18. The classification of the Indo-Aryan languages into *kentum* and *satem* and *k* and *p* forms is correlated with head forms and with the migrations. It seems evident that Sanskrit was developed long after the Latin and Greek tribes had left Asia.

19. The Neolithic Alpines spoke a more advanced language than the

Romans or Greeks. It was akin to Sanskrit, and the Romance languages are not developed from Latin but are merely Alpine tongues slightly modified by the Roman speech.

20. The Semitic tongues are akin in structure and vocabulary to the Melanesian languages. It seems probable that the linguistic links joining Hamitic to Semitic (and so to Aryan and to Alpine) can be more profitably studied in Melanesia than in the Mediterranean region, where the races are more intermingled.

21. Little comparative philology has been done on the Amerind languages, but it seems clear that they progress regularly from Iroquois through Algonquian and Athapascan to Shoshonean and Siouan. In the southern continent there is a parallel progression from Ges through Tupian, Cainguan, Arawakan, and Cariban up to Araucanian. This is, however, merely a suggestion based on the sequence found in other continents.

22. The writer can see no good reason for believing that the Paleo-Siberians (Chukchi, Yukaghir, etc.) evolved in America. The similarity of their languages with Amerind speech is in keeping with the analogous agreements found all over the world. But the migrations were the other way, from Asia to America. The same argument applies to the Eskimos who also moved from west to east.

23. The latest developments in speech and race occurred among the Alpines and late Mongolians. These are parallel variants of the same zone (83–88) who have remained fairly distinct because there has been a great physiographic barrier between them during the last 20,000 years or so.

24. The Chinese language, so far from being primitive, in many ways shows the type to which English (with its strong abbreviative and amalgamating tendency) is unconsciously evolving. Research on kindred dialects shows that Chinese had passed through the synthetic stage before the dawn of history. The development of early Turanian from late Aryan can be made out in northern India. Here again the Chinese come out near the apex of human evolution. Their only ethnic rivals are the Alpine folk extending from Savoy through Rhetia, Albania, etc., to Armenia and the Pamirs. These latter have not had so favorable an environment and so had not developed a high civilization before 3000 B. C. like the Chinese.

25. In an appendix some notes are added on the duration of the climatic cycles which cause the Ice Ages and which ultimately determined the major features of human evolution.

THE SECULAR VARIATION OF CLIMATE

By C. E. P. Brooks
Meteorological Office, Great Britain

The influence of variations of the sun's radiation on terrestrial climate has been the subject of many mathematical investigations. In former years these have dealt almost exclusively with the "sun-spot period" of approximately eleven years; more recently variations of shorter period, from a few days up to five years, have come into favor. But with all these periods the problem is complicated by the fact that the variations of terrestrial climate directly dependent upon variations in the supply of solar heat, themselves cause further terrestrial changes, and so on in an endless chain. Even the eleven-year "sun-spot period" is apparently not long enough for these repercussions to die down sufficiently to allow us a clear vision of the relation between the solar cause and the terrestrial effect. The shortest oscillations of a few days period have the advantage of instant and obvious action on temperature, but they have little effect on other elements and apply only in certain favored regions.

Table I—Sun-Spot Numbers, 1749–1918

Year	0	1	2	3	4	5	6	7	8	9
1740	..	..	..	..	..	..	..	..	..	81
1750	83	48	48	31	12	10	10	32	48	54
1760	63	86	61	45	36	21	11	38	70	106
1770	101	82	66	35	31	7	20	92	154	126
1780	85	68	38	23	10	24	83	132	131	118
1790	90	67	60	47	41	21	16	6	4	7
1800	14	34	45	43	48	42	28	10	8	2
1810	0	1	5	12	14	35	46	41	30	24
1820	16	7	4	2	8	17	39	50	62	67
1830	71	48	28	8	13	57	122	138	103	86
1840	63	37	24	11	15	40	62	98	124	96
1850	66	65	54	39	21	7	4	23	55	94
1860	96	77	59	44	47	30	16	7	37	74
1870	139	111	102	66	45	17	11	12	3	6
1880	32	54	60	64	64	52	25	13	7	6
1890	7	36	73	85	78	64	42	26	27	12
1900	10	3	5	24	42	64	54	62	49	44
1910	19	6	4	1	10	46	55	99	78	..

In these circumstances it seemed desirable to go to the other extreme and study the connected variations in what may be called their "secular" trend. Table I shows Wolfer's sun-spot "relative numbers" from 1750 to date, and Figure 1 shows the same numbers graphically, smoothed over an eleven-year period, each eleven-year mean being entered to the middle year. This brings out a longer variation of no particular period. The last chief maximum occurred about 1835; but the curve rose to almost the same point in 1870, and the subsequent decline is still in progress.

It is on this last phase that attention is concentrated in this study. By 1870, or shortly after, a large number of meteorological stations had been established in all parts of the world, and many long series of homogeneous

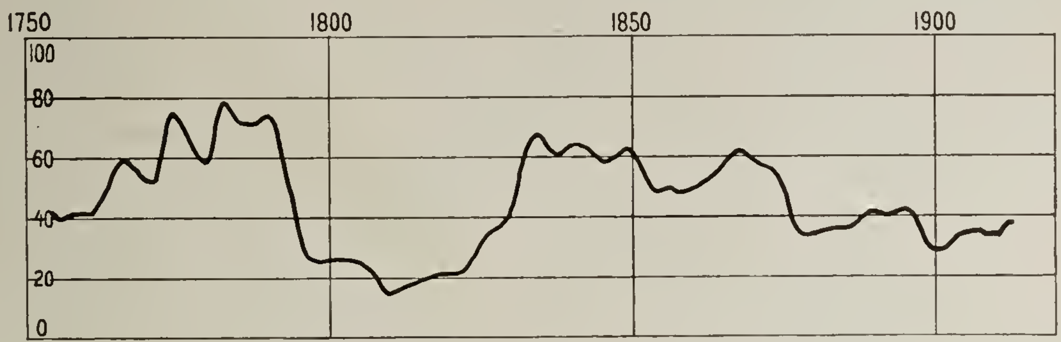


FIG. 1—Sun-spot numbers (eleven-year means).

observations are now available for study. Most of those employed here were collected by G. T. Walker of the Indian Meteorological Office for an investigation of the relations of climate and sun spots and were generously made available for other investigators;[1] a few other figures have been collected for unrepresented or specially interesting areas. These figures have been analyzed for secular variation by the method of correlating with time.

The process is as follows: The series of, say, mean annual pressures are represented by deviations, $p1, p2, p3, \ldots pn$, from their common average and arranged in a column with their earliest year at the top. Against the middle year of the series is written 0, and from this line the figures $-1, -2, \ldots -n/2$ are written upwards and the figures $1, 2, \ldots n/2$ downwards so that the earliest year has the value $-n/2$ and the latest year $n/2$. The following sums are then calculated:

the squares of $p1, p2, \ldots pn = \Sigma p^2$
the squares of $-n/2, -n/2+1, \ldots +n/2 = \Sigma y^2 = n(n+1)(2n+1)/3$
the products $p1(-n/2), p2(-n/2+1), \ldots pn(n/2) = \Sigma p.y$

The correlation coefficient r is given by the formula:

$$r = \frac{\Sigma p.y}{\sqrt{\Sigma p^2 \Sigma y^2}}$$

[1] G. T. Walker: Correlation in Seasonal Variations of Weather, *Memoirs Indian Meteorol. Dept.*, Vol. 21, Parts IX–XII, (= pp. 12–118), Simla, 1914, 1915.

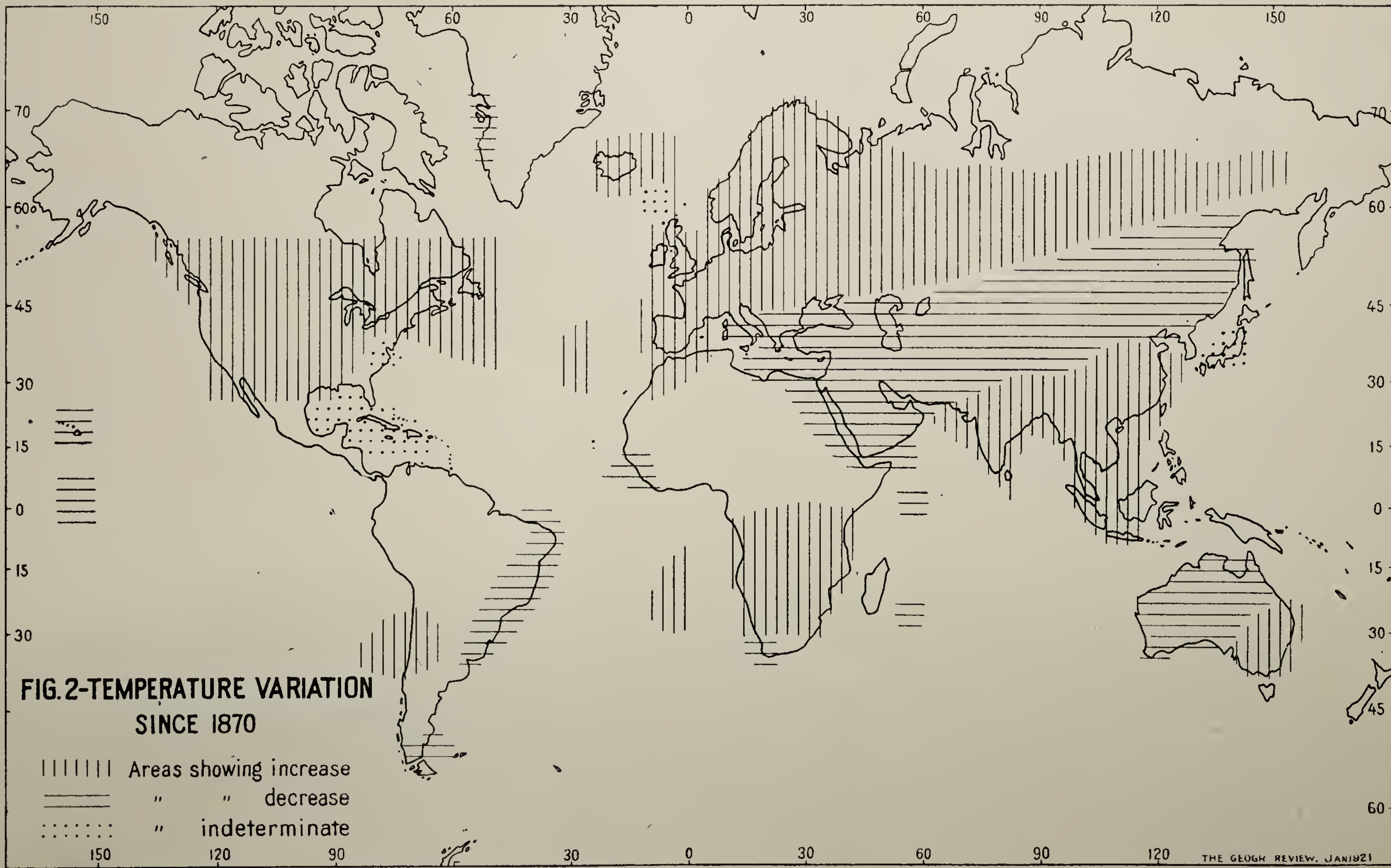


FIG. 2—TEMPERATURE VARIATION SINCE 1870

This gives the closeness of the connection between the variations of pressure at the station in question and the advance of time. A perfectly regular increase of pressure gives a correlation coefficient of $+1$, complete independence gives 0, and a perfectly regular decrease gives -1.

A figure of greater practical value is represented by b, which is the coefficient of the regression equation:

$$p = b.y$$

b thus gives the average amount by which pressure increases or decreases each year. Finally e is the probable error of the correlation coefficient, which means that the chances are even whether the real value of r, as distinct from the calculated value, lies between or outside the limits $r + e$ and $r - e$. For a value of r to have an undoubted significance it should be at least three times the value of e, unless other considerations come in.

Since the figure which is being employed ultimately—the average change per year—could have been calculated much more rapidly by a simple application of the method of least squares,[2] it may be asked why go to the labor of computing correlation coefficients? The answer is that the latter show how much of the observed standard deviation can be attributed to the secular variation and how much is due to other causes. The results of this part of the investigation will be referred to later, in connection with Table II, which gives the values of r, b, and e for a large number of stations, classified geographically, for pressure and temperature. Similar values for rainfall were communicated to the Royal Meteorological Society recently in a paper entitled "The secular variation of rainfall."[3]

Distribution of Climatic Changes

So much for the mathematical part of the investigation. In Figures 2, 3, and 4 are shown the results of plotting the values of b. Areas where the element in question has been increasing since 1870 are shown by vertical shading, areas of decrease by horizontal shading; indeterminate areas are stippled, and unrepresented regions are left blank. The results are sufficiently striking. Considering first temperature (Fig. 2), we have the ollowing definite areas of increase:

1. Temperate North America, most of Europe, and northern Siberia.
2. Southeastern Asia.
3. Northern Chile, South Africa except the tip, and southeastern Australia.

Areas of decrease are:

4. Western Greenland.
5. A belt including eastern South America, most of northern Africa, Arabia, and Central Asia to Saghalien.
6. Most of Australia and the tropical Pacific.

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[2] E.g. by the formula: $b = \dfrac{3\Sigma\, p.y}{n\,(n + 1)\,(2n + 1)}$

p being deviation from normal and y difference of date from middle year.

[3] *Quart. Journ. Royal Meteorol. Soc.*, No. 191, Vol. 45, 1919, pp. 233–248.

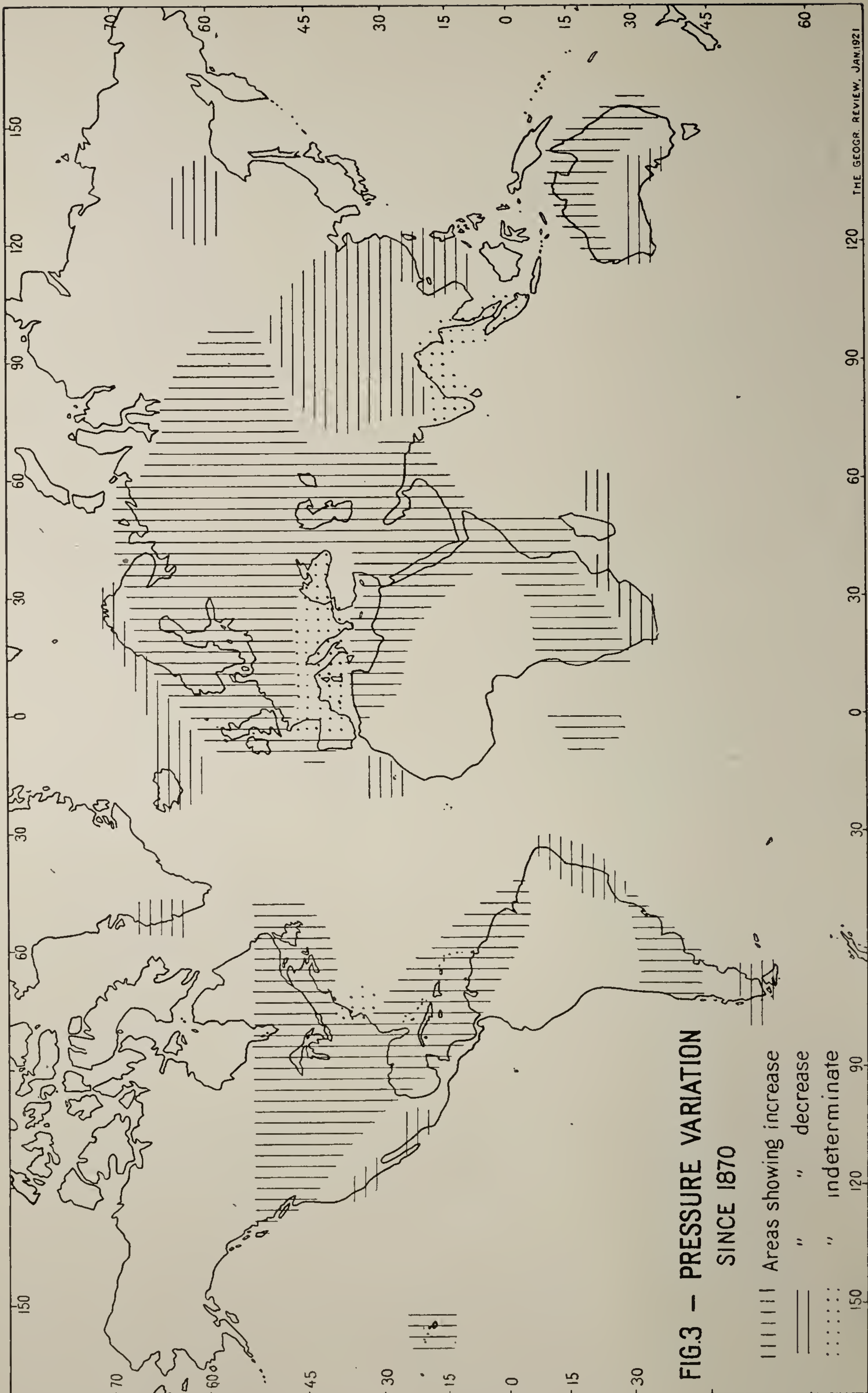

FIG.3 — PRESSURE VARIATION SINCE 1870

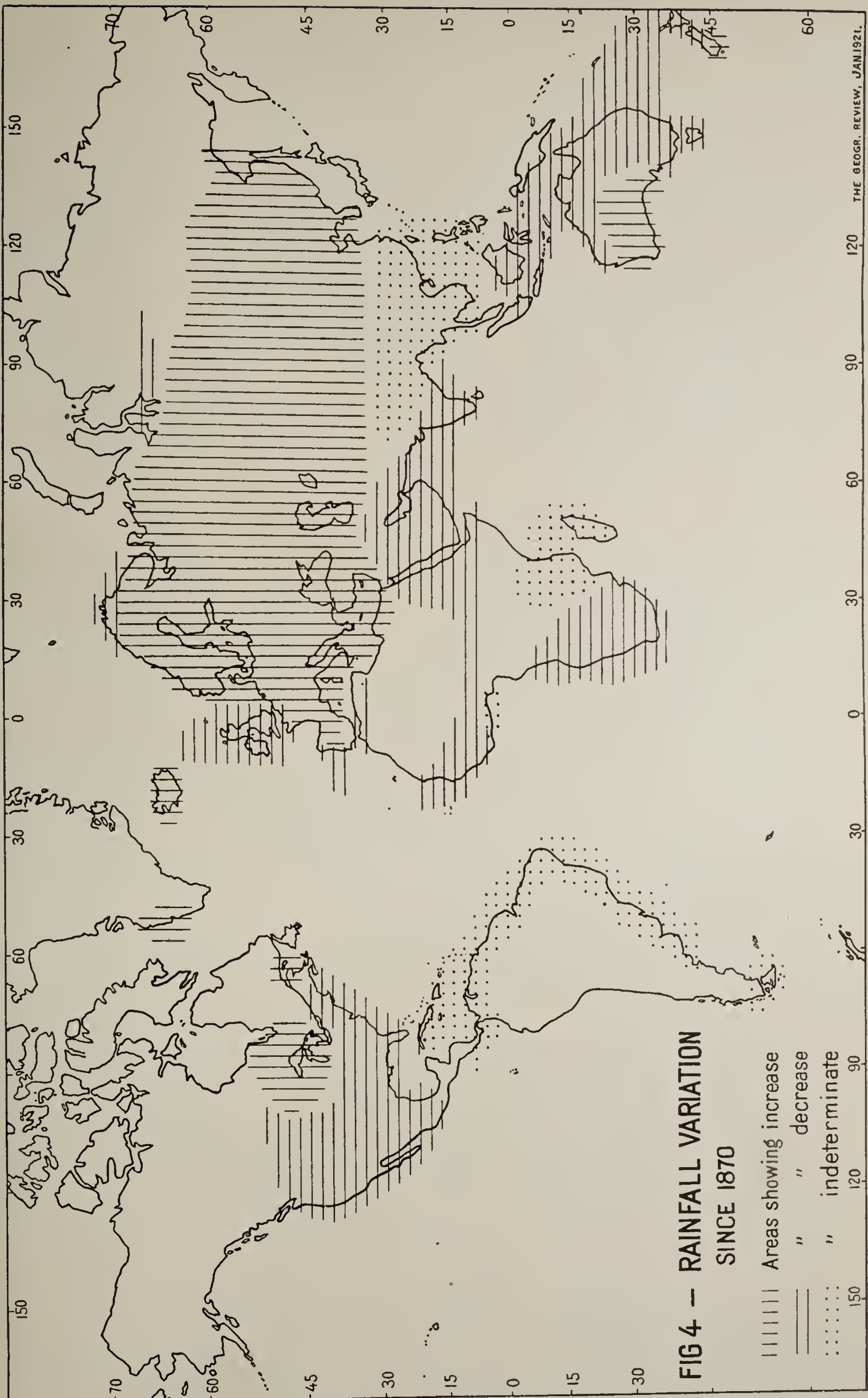

FIG 4 — RAINFALL VARIATION SINCE 1870

Similar areas can be determined in the maps of pressure (Fig. 3) and rainfall (Fig. 4).

Now we have to bear in mind two important points:

1. A decrease in sun-spot numbers is closely associated with a decrease in the total amount of radiation emitted by the sun. Consequently since 1870 the solar radiation reaching the upper limit of the earth's atmosphere has been decreasing.

2. The world may be classified into two types of climatic areas:
   A. Dependent directly on the heat received from the sun—most of the tropics; Central Asia.
   B. Dependent more closely on variations in the atmospheric circulation—the temperate storm belts and the permanent subtropical anticyclonic regions.

Changes in Tropical Regions

Returning to Figure 2, we find a tendency for the equatorial regions to show a fall of temperature since 1870. This is of great interest, as it is conformable with the decrease of heat received at the limit of the earth's atmosphere, instead of being opposed to it as in the case of the eleven-year period. The theory of the latter is that owing to the peculiar properties and action of the earth's atmosphere, a small increase in the total heat received results in an actual decrease of temperature at the earth's surface. But obviously this process has limits, and even in the sun-spot period the minimum temperature occurs about two years before spot maximum. It seems that the much greater range of solar heat in the last forty or more years has sufficed to overpower this secondary effect and give the temperature variation in the tropics a course roughly parallel to that of the solar heat. But it will be seen later that where the sun-spot secular variation curve flattens out there is a tendency for the temperature to rise again in spite of the fall during the earlier period.

The chief exception to the progressive fall in the tropics is the monsoonal region of southeastern Asia. In the interior of Asia the decrease of temperature has been very marked. Figure 3 shows that the decrease of temperature in the equatorial regions has been accompanied very closely by a rise of pressure, and Figure 4 shows a corresponding decrease of rainfall. In both cases the relationship is obvious: the air has become colder; hence it has also become heavier, while evaporation and therefore rainfall have diminished.

Changes in Extratropical Regions

In the regions dependent chiefly on the variations of the atmospheric circulation the case is more complicated. The strength of the circulation in extratropical regions depends chiefly upon the relative intensity of the low-pressure centers in the cold temperate zone, compared with the subtropical

anticyclonic belts. The latter have shared in the equatorial rise of pressure, and, since the average pressure over the globe must remain approximately the same from year to year, this rise implies a corresponding decrease in higher latitudes. Consequently there should have been an increase in the poleward pressure gradient giving increased strength to the prevailing westerly winds of temperate latitudes. The map (Fig. 3) shows increases of pressure at Honolulu, over the West Indies anticyclonic region, and over northern Africa in the northern hemisphere; also over the subtropical high pressure belt in South America, South Africa, and northern Australia in the southern hemisphere. California seems to be an exception. On the other hand, there has been a fall of pressure in the Iceland-Greenland minimum and over the storm centers of Tierra del Fuego, Cape Colony, and the southern coast of Australia. So far so good.

Northwestern Europe

The relations of pressure variations to temperature and rainfall are shown best in the storm area of northwestern Europe. The marked decrease in the pressure at Iceland (60 units) and Greenland (71 units), combined with the increase over Europe, must have increased the strength of the southwesterly winds very considerably. The normal pressure difference between Iceland and southeastern England is about 12 millibars. During the last forty years this has increased at the average rate of about 0.1 mb. a year, a difference of 4 mb. between the first and last years of the series, which means that the resultant southwesterly current must have increased by almost 50 per cent during that period, a very important change. Hence a steady increase in the temperature of western Europe. The pressure decrease apparently extended into the Arctic Ocean (Vardo 9 units) and northern Siberia (Irkutsk 19, Yakutsk 20 units), and under its influence the belt of rising temperature passed right across the Siberian plain almost to the Pacific, its southern limit gradually shifting polewards on the way. There has been at the same time an increase of precipitation (except over the British Isles, which lose rainfall when depressions are able to pass rapidly northeastwards instead of hanging round the Atlantic coast). On the western side of the Iceland-Greenland minimum there must have been an increase of northerly winds, and a fall of temperature is shown. The increase of rainfall probably indicates an increased westerly or on-shore component in the wind.

Storm Belt of the Southern Hemisphere

In the storm belt of the southern hemisphere conditions are different in that there is no equatorial component in the wind, which is almost due west at Cape Horn and rather southwest at Cape Town and Perth, Western Australia. Consequently increasing the pressure gradient increases the cloudiness without bringing in warmer air, and a fall is shown in the temperature. Eastern Australia is an exception; here the wind normally comes from

lower latitudes, and there has been an increased northwesterly gradient; hence more warm air has come in and temperature has risen; but, as the air is from the dry interior, rainfall has decreased.

Temperate North America

Temperate North America shows rather curious conditions. There has been a definite rise of pressure, except for a slight fall in the coastal regions of California. This is part of the general rise over the continents. It is unfortunate that there is no long uniform series from Alaska. The normal pressure gradient favors northwesterly winds over North America, and the general trend of pressure changes since 1870 has been to weaken this gradient; hence higher temperatures. At the same time the more anticyclonic conditions caused a decrease of the rainfall, except in eastern Canada, which has come under the influence of easterly oceanic winds from the Atlantic, caused by the relative increase of pressure over the St. Lawrence estuary and bringing increased rainfall.

Monsoon Area of Southeastern Asia

A remarkable exception to the general trend of variation in the tropics is shown by the monsoon area of southeastern Asia. Instead of falling temperature, rising pressure, and decreasing rainfall, this unit shows rising temperature over approximately its whole area and, except in southern India, falling pressure and indeterminate rainfall. Southern India has apparently been unable entirely to throw off its tropical characteristics and shows indefinite pressure variations and decreasing rainfall. The cause of these exceptional variations is obscure but can reasonably be connected with the variations farther north. The general changes of pressure over Siberia indicate an increase of the westerly component of the wind and a decrease of the northerly component. This means that the cold air of northern Siberia is carried off eastward and that less of it penetrates to southern Asia as the northeasterly monsoon. This monsoon is the principal agent in lowering the temperature there. There results an increased average temperature in the regions subject to the northerly winds in winter, which in turn lowers the pressure. The gradient for the southerly monsoon becomes stronger, and this further raises the temperature and contends, though with only partial success, against the normal tendency of equatorial regions towards an increasing drought.

Practical Value of This Study

Having discussed briefly the extremely interesting principles of the mechanism of climatic changes raised by this study, a word may be said as to its practical value. It often happens in climatological work that a series of figures of, say, rainfall is not strictly homogeneous. There may have been a change of station from one part of the town to another. By means of an

overlapping period factors may be obtained for reducing the earlier series to the same conditions as the later. The reduction may appear to be sound, and yet some doubt may attach to the result. A single example will suffice. In the course of preparing normals for use in the *Reseau Mondial*, a rainfall series at Villa Colon (1883–1905) was combined with a later one at the Central Observatory (1901–1918) to obtain a long-period normal of rainfall at Montevideo. The overlapping period of five years should have sufficed, considering the near neighborhood of the two stations, but on completing the work the earlier series was found to show a considerably smaller rainfall than the later series. The figures actually were: 1883–1900, 32.0 inches a year; 1901–1918, 39.0 inches a year.

This indicates a value of b equal to + 0.4 inches, i.e. the rainfall has been increasing at the average rate of 0.4 inches a year. This is considerable and would have thrown suspicion on the accuracy of the reduction; but reference to the rainfall paper already cited showed for Buenos Aires a value of + 0.75 inches for b during the period 1861–1907. This sufficiently confirms the increase at Montevideo, and the long period normal was accepted. A similar method has been applied to many doubtful series, with great success in separating the sound from the unsound.

The values of the correlation coefficients given in Table II are not in general large. This was to be expected and merely shows that the amount of the average year to year change throughout the whole period is not sufficient to dominate the irregular fluctuations and variations of the short period. Considering the multiplicity of agents which affect climate, it would indeed have been surprising if any other result had been found. Even so, some very remarkable results may be noted. In the West Indies we have two concordant high values of pressure: + .75 at San Juan, Porto Rico, and + .78 at Havana, continued in a northwesterly direction by + .36 at Key West, + .33 at Galveston, and + .46 at Denver, Colo., and in a southeasterly direction by + .20 at Para and + .61 at Blumenau—the six stations having a mean value of + .56. In southeastern Asia we have − .60 at Manila, − .33 at Hongkong, and − .39 at Zikawei. An area of high positive coefficients is found in eastern and northern Australia. These are all tropical or subtropical regions where the irregular fluctuations reach a minimum; in higher latitudes the reverse is the case, but even here we have to notice − .48 at Jacobshavn and − .39 at Stykkisholm.

In the case of temperature the values are as a whole smaller, indicating greater irregularity in this element. The thirteen stations in northern Europe, which are all positive, have a mean value of only − .23. The highest numerical value is − .76 at Mauritius; but western and northern Australia have also some high negative values: − .70 at Carnarvon, − .31 at Alice Springs and Port Darwin, and − .59 at Perth—mean − .48. For rainfall I may quote a high positive area in central Siberia (mean of five stations + .54) and a highly negative area between Sierra Leone and the Azores (mean of four stations − .47).

Table II—Results of Correlation of Mean Annual Pressure and Temperatures with Time

Station	Lat. Deg. Min.	Long. Deg. Min.	Pressure No. Yrs.	Pressure σ	Pressure r	Pressure e	Pressure b	Temperature No. Yrs.	Temperature σ	Temperature r	Temperature e	Temperature b
				mb/100			mb/1000		°C			°C/1000
North America	N	W										
Albany, N. Y.	42 39	73 45	39	74	+.11	.10	+2	36	0.84	+.18	.11	+13
Denver, Colo.	39 45	105 0	40	47	+.46	.08	+19	40	0.64	.00	.11	0
Galveston, Tex.	29 18	94 50	40	71	+.33	.09	+20	40	0.47	+.06	.10	+2
Helena, Mont.	46 34	112 4	31	54	+.22	.12	+13	33	0.75	+.08	.11	+7
Key West, Fla.	24 34	81 49	40	54	+.36	.09	+18	40	0.49	−.55	.07	−23
St. Louis, Mo.	38 38	90 12	..	....	....	..	....	40	0.72	+.17	.10	+11
San Diego, Cal.	32 43	117 10	40	57	−.07	.10	−3	40	0.52	−.07	.11	−4
Sydney, N. S.	46 10	60 10	36	90	+.43	.09	+36	36	0.74	+.14	.11	+10
Toronto	43 29	79 23	41	63	+.05	.10	+3	36	0.88	+.37	.09	+32
Victoria, B. C.	48 24	123 19	21	74	+.26	.14	+31	22	0.73	+.57	.10	+66
Washington, D. C. . .	38 54	77 3	40	69	−.20	.10	−12	40	0.57	−.19	.10	−9
Winnipeg, Man. . . .	49 51	97 7	20	78	+.18	.14	+21	20	1.07	+.61	.10	+100
Iceland, Greenland, and Faroes												
Jacobshavn	69 13	51 2	42	180	−.48	.08	−71	38	1.41	−.05	.11	−6
Stykkisholm	65 5	22 46	42	185	−.39	.09	−60	42	0.78	+.27	.09	+17
Thorshavn	62 22	6 44	42	143	−.06	.10	−7	39	0.44	−.03	.11	−1
Northern Europe												
Archangel	64 33	40 32 E	34	166	+.32	.10	+55	26	1.10	+.27	.12	+27
Basel	47 33	7 35 E	41	96	−.03	.10	−2	38	0.58	+.01	.11	+5
Christiansund	63 7	7 45 E	45	144	+.11	.10	+12	37	0.65	+.34	.10	+19
Greenwich	51 29	0 0	41	142	+.30	.09	+36	41	0.58	+.22	.10	+11
Hamburg	53 33	9 59 E	36	107	+.06	.11	+5	36	0.64	+.62	.07	+38
Kieff.	50 26	30 31 E	..	....	....	..	....	38	0.81	+.19	.10	+14
Lugansk	48 35	39 20 E	..	....	....	..	....	35	0.86	+.33	.10	+28
Moscow	55 46	37 40 E	..	....	....	..	....	38	0.95	+.13	.11	+11
Petrograd	59 56	30 16 E	38	140	+.02	.11	+3	38	1.01	+.21	.10	+19
Valencia	51 56	10 15W	43	179	+.04	.10	+6	27	0.36	+.09	.13	+4
Vardo	70 22	31 8 E	42	155	−.07	.10	−9	39	0.78	+.13	.10	+9
Vienna	48 15	16 21 E	40	89	+.10	.10	+7	41	0.60	+.12	.10	+6
Warsaw	52 14	21 2 E	38	81	+.39	.09	+29	38	0.79	+.28	.10	+20
Northern Asia	N	E										
Astrachan	46 15	48 4	30	73	+.27	.11	+20	24	0.68	−.09	.13	−6
Barnaul	53 20	83 47	38	101	+.17	.10	+15	38	0.85	+.38	.09	+29
Ekaterinburg	56 50	60 38	..	....	....	..	....	38	0.77	+.18	.10	+13
Yeniseisk	58 27	92 6	34	148	+.02	.11	+3	34	1.09	+.40	.10	+40
Irgiz	49 30	60 18	..	....	....	..	....	27	0.90	+.17	.12	+20
Irkutsk	52 16	104 19	35	136	−.15	.11	−19	35	0.43	−.50	.08	−21
Yakutsk	62 1	129 43	19	101	−.12	.15	−20	19	0.81	+.03	.15	+4
Nikolaevsk	53 8	140 45	..	....	....	..	....	31	0.70	−.07	.12	−5
Obdorsk	66 31	66 35	..	....	....	..	....	25	1.40	+.41	.11	+77
Tashkent	41 20	69 18	30	108	−.11	.12	−11	30	0.73	−.28	.11	−19
Turukhansk	65 55	87 38	..	....	....	..	....	22	1.06	+.25	.13	+35
Central America and West Indies	N	W										
Barbados	13 8	59 40	29	51	+.13	.12	+7	..	...	....	..	....
Bermuda	32 18	64 47	29	88	−.33	.11	−32	..	...	....	..	....
Grenada	12 5	61 40	..	....	....	..	....	25	0.23	+.45	.11	+15
Havana	23 0	82 15	40	72	+.78	.04	+53	..	...	....	..	....
Mexico City	19 26	99 8	34	57	−.07	.11	−4	34	0.36	−.01	.11	−1
San Juan, Porto Rico .	18 25	66 7	40	75	+.75	.05	+52	..	..	....	..	....
Mediterranean Region and Arabia												
Aden	12 45	45 3 E	32	40	+.33	.11	+14	30	0.28	−.10	.12	−3
Lisbon	38 43	9 9W	40	81	+.51	.08	+55	28	0.58	+.49	.10	+35
Malta	35 54	14 31 E	..	....	....	..	....	30	0.51	−.03	.12	−1
Palermo	38 7	13 22 E	28	69	.00	.13	0	..	...	....	..	....
Ponta Delgada	37 45	25 41W	..	....	....	..	....	25	0.43	+.19	.13	+9
Rome	41 54	12 27 E	..	....	....	..	....	40	0.37	−.10	.10	−3
Skutari	41 0	29 3 E	33	69	−.28	.11	−10	33	0.56	−.03	.12	−2
Tiflis	41 43	44 48 E	38	55	+.35	.09	+18	38	0.62	−.51	.08	−29

TABLE II—(*Continued*)

Station	Lat. Deg. Min.	Long. Deg. Min.	Pressure No. Yrs.	Pressure σ	Pressure r	Pressure e	Pressure b	Temperature No. Yrs.	Temperature σ	Temperature r	Temperature e	Temperature b
				mb/100			mb/1000		°C			°C/1000
INDIA AND PERSIA	N	E										
Agra	27 10	78 5	39	49	−.25	.10	−11	39	0.49	+.09	.11	+4
Bagdad	33 21	44 28	17	41	+.04	.16	+3	21	0.72	+.21	.14	+23
Bombay	18 54	72 49	43	41	+.01	.10	0	36	0.34	+.46	.09	+15
Bushire	28 59	50 49	34	41	+.03	.11	+1	34	0.48	−.29	.10	−13
Calcutta	22 32	88 20	43	39	+.03	.10	+1	36	0.36	+.41	.09	+14
Colombo	6 56	79 32	44	41	+.11	.10	+4	39	0.31	+.24	.10	+7
Leh	34 10	77 42	34	83	+.50	.09	+41	36	0.77	−.52	.08	−37
Madras	13 4	80 14	43	44	−.14	.10	−5	36	0.30	+.45	.09	−13
Rangoon	16 46	96 13	38	43	+.20	.10	+8	38	0.36	+.09	.11	+3
SOUTHEASTERN ASIA												
Batavia	6 11 S	106 50	40	48	+.01	.10	0	40	0.49	+.38	.0	+16
Hongkong	22 18 N	114 11	28	47	−.33	.11	−19	28	0.35	+.50	.09	+21
Manila	14 35 N	120 58	34	59	−.60	.07	−35	34	0.45	−.54	.08	−25
Nagasaki	32 48 N	129 57	26	56	+.17	.13	+12	33	0.54	−.17	.11	−9
Peking	39 57 N	116 28	..	....	....	..	....	27	0.46	−.23	.12	−9
Tokyo	35 41 N	139 45	39	45	+.01	.11	0	36	0.47	+.03	.11	+2
Zikawei	31 12 N	119 6	37	44	−.39	.09	−16	37	0.41	+.15	.11	+6
SOUTH AMERICA NORTH OF 30°S.	S	W										
Bahia	12 54	38 24	20	20	+.12	.15	+4	20	0.53	−.25	.14	−23
Blumenau	26 55	49 3	20	174	+.61	.10	+182	20	0.58	−.50	.11	−51
Para	1 28	48 24	15	20	+.20	.17	+9	..	...	....	..	....
Recife	8 5	34 50	22	105	−.16	.14	−22	22	0.28	−.36	.12	−14
Rio de Janeiro	22 54	43 10	39	68	−.13	.10	−8	39	0.69	−.38	.09	−23
AFRICA NORTH OF 30°S.												
Abbassia	30 5 N	31 17 E	42	62	+.48	.08	+24	40	0.77	−.38	.09	−25
Algiers	36 48 N	3 2 E	24	68	+.42	.11	+41	24	0.54	+.03	.14	+2
Durban	29 51 S	30 30 E	34	71	−.66	.07	−49	33	0.60	+.26	.11	+16
Sierra Leone	8 30 N	13 9 W	..	....	....	..	....	30	0.48	−.30	.09	−13
Zanzibar	6 10 S	39 11 E	22	33	+.33	.13	+18	22	0.26	+.11	.14	+4
TROPICAL OCEANIC ISLANDS												
Honolulu	21 18 N	157 50 W	30	64	+.13	.12	+10	38	0.35	−.67	.06	−21
Malden Island	3 59 S	155 0 W	..	....	....	..	....	27	0.41	−.27	.12	−13
Mauritius	20 6 S	57 33 E	39	58	−.58	.07	−30	38	0.46	−.76	.05	−31
St. Helena	15 55 S	5 43 W	18	34	+.48	.12	+30	27	0.39	+.48	.10	+30
Seychelles	4 45 S	55 45 E	19	38	+.19	.15	+13	20	0.43	−.18	.14	−13
Teneriffe	28 25 N	16 32 W	30	72	−.46	.10	−28	..	...	....	..	....
AUSTRALIA NORTH OF 30°S.	S	E										
Alice Springs	23 38	133 37	31	74	−.06	.12	−4	30	0.71	−.31	.11	−22
Brisbane	27 28	153 6	27	88	+.27	.12	+30	27	0.34	+.59	.08	+26
Carnarvon	24 54	113 39	22	85	+.59	.09	+69	19	0.51	−.70	.08	−46
Derby	17 18	123 39	20	64	+.08	.15	+ 9	19	0.59	−.14	.15	−14
Port Darwin	12 28	130 51	32	81	+.54	.09	+47	36	0.47	−.31	.10	−14
SOUTHERN SOUTH AMERICA	S	W										
Buenos Aires	34 36	58 22	40	60	+.11	.10	+6	43	0.51	−.16	.10	−6
Córdoba	31 25	64 12	41	60	+.25	.10	+13	41	0.61	+.16	.10	+8
Punta Arenas	53 10	70 54	19	150	−.30	.14	−21	20	0.73	−.21	.14	−26
Santiago	33 30	70 30	43	48	+.06	.10	+2	43	0.49	+.07	.10	+3
SOUTH AFRICA	S	E										
Cape Town	33 56	18 29	33	37	−.05	.11	−2	31	0.30	−.37	.10	−12
AUSTRALASIA SOUTH OF 30°S.												
Adelaide	34 57	138 35	33	83	−.17	.11	−15	38	0.36	.00	.11	0
Albany, W. A.	35 2	117 53	24	88	−.31	.12	−41	..	...	....	..	....
Auckland	....	....	..	....	....	..	....	38	0.46	−.37	.09	−13
Perth	31 57	115 52	29	74	−.01	.12	−1	36	0.50	−.59	.07	−26
Sydney	33 52	151 12	43	96	+.47	.08	+37	43	0.25	+.20	.10	+4

The Governing Factor in Temperature Variation

Two interesting points which arose in the course of the work may be referred to. The first is the distribution of the variation of temperature with time between the mean daily maximum and the mean daily minimum temperatures. Long series were readily available for only three stations, St. Helena, Grenada (West Indies), and Sierra Leone. These showed the following values:

		σ Degrees Centigrade	r	b Degrees Centigrade
St. Helena	Mean maximum	0.91	+.69	+.081
	Mean minimum	0.31	−.44	−.018
	Mean	0.39	+.48	+.031
Grenada	Mean maximum	0.34	+.39	+.018
	Mean minimum	0.21	+.45	+.013
	Mean	0.23	+.45	+.015
Sierra Leone	Mean maximum	0.53	−.59	−.023
	Mean minimum	0.70	−.05	−.003
	Mean	0.48	−.30	−.013

These three examples show that the governing factor in the temperature variation is the day temperature. In the case of St. Helena we have the remarkable fact that while the maximum temperatures have been increasing, the minima have been decreasing, giving an average increase in the daily range of one degree centigrade in ten years—an important climatological effect. At the other stations the variation of the minima is in the same direction as that of the maxima but is apparently less rapid. A general examination of the figures at seventeen tropical stations was made (see Table III), and, though the series are generally less than twenty years in length, certain facts could be definitely ascertained.

1. Stations may be divided roughly into two groups:

   A. Tropical islands and continental stations in arid districts or at high levels.

   B. Coastal stations.

2. At stations in group A the maxima vary much more than the minima; at coastal stations the ratio ranges about unity.

3. In group A the maxima alone show any marked relation to time, the value of *b* averaging about 0.14° F., i.e. the mean for the decade 1910–1919 is about 1.4 degrees higher than that for the decade 1900–1909.

It should be noted that the first period (average period about 1903–1909) is one of considerably higher sun-spot numbers than the second (about 1910–1915), which partly accounts for the general rise of temperature shown.

TABLE III—MEAN DAILY MAXIMUM AND MINIMUM TEMPERATURES AT TROPICAL STATIONS
(In degrees Fahrenheit)

	Mean Daily Maximum			Mean Daily Minimum		
	1900–09	1910–19	Change	1900–09	1910–19	Change
A. Island Stations						
Fanning Island	85.6	88.2	+2.6	76.7	76.6	−0.1
Malden Island	90.2	90.0	−0.2	75.0	74.3	−0.7
Ocean Island	89.2	88.3	−0.9	75.2	76.2	+1.0
St. Helena	66.3	68.7	+2.4	56.3	56.5	+0.2
Tulagi, Solomon Is.	84.7	87.7	+3.0	75.5	76.1	+0.6
Mean	83.2	84.6	+1.4	71.7	71.9	+0.2
Interior Stations						
Entebbe	78.0	79.1	+1.1	63.2	62.8	−0.4
Kontagora	91.1	93.4	+2.3	68.7	67.9	−0.8
Maiduguri	97.5	97.8	+0.3	67.3	68.3	+1.0
Yola	91.8	93.6	+1.8	70.9	72.2	+1.3
Zungeru	92.2	93.1	+0.9	70.1	70.3	+0.2
Mean	90.1	91.4	+1.3	68.0	68.3	+0.3
B. Coastal Stations						
Accra	85.2	85.4	+0.2	72.4	72.3	−0.1
Bathurst	85.7	86.0	+0.3	69.9	68.9	−1.0
Cape Coast Castle	85.5	85.4	−0.1	73.3	71.5	−1.8
Grenada	83.8	84.0	+0.2	73.9	74.2	+0.3
Lagos	86.3	86.9	+0.6	75.0	74.8	−0.2
Sandakan, Borneo	88.5	88.7	+0.2	75.5	75.4	−0.1
Sierra Leone	88.2	88.1	−0.1	73.4	72.8	−0.6
Mean	86.2	86.4	+0.2	73.3	72.8	−0.5

NOTE. The series mostly begin about 1903 or 1904 and end about 1917.

Tendency Toward Decreasing Deviation from Normal

The second point is the remarkable tendency which has existed during the last forty years for a numerical decrease in the deviations from normal. This has been brought out by dividing the whole period at each station into two halves and summing the squares of the deviations independently in each half. Calling the standard deviation of the first period A and that of the second period B, we find the following distribution (only long complete series were used):

		B greater than A B/A			A greater than B A/B		
		>2	2−1.33	1.33−1	1−1.33	1.33−2	>2
Pressure	Number	0	9	7	9	21	12
	Per cent	0	15	12	16	36	21
Temperature	Number	2	5	9	19	13	7
	Per cent	4	9	16	35	23	13

The phenomenon is most marked in the case of pressure, where in 33 cases, or 44 per cent, the standard deviation in the first period exceeded that in the second by at least 33 per cent, while in 12 cases the excess was at least 100 per cent. In temperature the distribution is less striking; but in 71 per cent the deviation in the first period exceeded that in the second and was more than double it in 13 per cent, compared with only 4 per cent when it was less than half. The individual stations were as follows:

Pressure: B/A 2—1.33: Abbassia, Aden, Córdoba, Denver, Galveston, Hamburg, St. Helena, Jacobshavn, Mexico City.

B/A 1.33—1: Basel, Bushire, Leh, Lisbon, Port Darwin, Vienna, Warsaw.

A/B 1—1.33: Batavia, Colombo, Havana, Hongkong, Manila, Skutari, Stykkisholm, Tokyo, Valencia.

A/B 1.33—2: Adelaide, Albany (N. Y.), Archangel, Barnaul, Bombay, Buenos Aires, Calcutta, Cape Town, Christiansund, Honolulu, Mauritius, Perth (W. A.), Petrograd, San Diego, San Juan, (P. R.), Sydney (Nova Scotia), Thorshavn, Tiflis, Toronto, Washington, Zikawei.

A/B more than 2: Agra, Durban, Yeniseisk, Greenwich, Irkutsk, Key West, Lugansk, Rangoon, Rio de Janeiro, Santiago, Sydney (N.S.W.), Vardo.

Temperature: B/A more than 2: Adelaide, Buenos Aires.

B/A 2—1.33: Colombo, Córdoba, Denver, Galveston, Mexico City.

B/A 1.33—1: Bombay, Greenwich, St. Helena, Honolulu, Irkutsk, Jacobshavn, Lugansk, St. Louis, Washington.

A/B 1—1.33: Agra, Archangel, Barnaul, Batavia, Calcutta, Ekaterinburg, Hamburg, Hongkong, Key West, Madras, Manila, Mauritius, Moscow, Petrograd, Port Darwin, San Diego, Sydney (Nova Scotia), Vardo, Zikawei.

A/B 1.33—2: Basel, Cape Town, Christiansund, Kieff, Leh, Nagasaki, Rio de Janeiro, Stykkisholm, Sydney (N.S.W.), Tiflis, Tokyo, Toronto, Vienna.

A/B more than 2: Abbassia, Yeniseisk, Perth (W.A.), Rangoon, Santiago, Thorshavn, Warsaw.

This list shows that both with pressure and temperature the preponderant standard deviation of the earlier years is found chiefly in the belt of decreasing pressure over northern Europe and Siberia and also in India, the West Indies, the New England states, and the eastern coast of Australia. The reverse, B greater than A, is more restricted, being found chiefly in the Mediterranean region and the interior of America. These facts are of great interest; they may be paralleled with the investigations of J. von Hann and Liznar, who found that the absolute variability of temperature as shown by the annual range is greater at times of spot maximum than at spot minimum. A similar result for the range of daily maximum temperatures was found by MacDowall for Geneva. No similar direct results for pressure anomalies have been discovered, but there is a classical paper by Meldrum in which he shows that the cyclones of the Indian Ocean have a marked maximum frequency at spot maximum and minimum frequency at spot minimum. Similar results have been obtained by Poey in the Antilles, and these phenomena may be considered as analogous to the decreasing pressure irregularities with decreasing sun-spot numbers. The two exceptions, the Mediterranean and the interior of the United States, are apparently due to a

tendency of depressions to follow more southerly tracks at times of few sun spots, thus increasing the variation of pressure and temperature in the regions traversed by these tracks.

Conclusion

Finally, I must admit that the results set out in this paper need to be considered as a preliminary survey only. For the tropical islands especially the series of observations are rarely long enough for such a statistical investigation, though for the purpose of a comparison of solar and terrestrial changes these islands are of great importance as giving relatively simple conditions. But, when it is seen that secular trend may appreciably modify the climate of a place within the relatively short period of forty years, I hope that investigators of the climatic conditions of various localities will realize the importance of this element of climate and, with fuller information at their command, will check the accuracy of the results or fill in the details at present necessarily left blank.

THE CHICAGO MEETING OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS

The sixteenth annual meeting of the Association of American Geographers was held in Chicago on Thursday, Friday, and Saturday, December 30–31, 1920, and January 1, 1921. Doubtless all who were present would vote the program of this meeting one of the most interesting in the history of the Association. The first group of papers was meteorological and climatological in character. Prof. O. L. Fassig described the organization of the climatological service of the West Indies, illustrating his paper with charts showing the location of stations and the comparative value of the data by regions. Dr. C. F. Brooks referred to recent observations on the well-known appearance of cold surf with off-shore winds. Professor Jefferson remarked, in discussion, that the phenomenon of cold water with off-shore winds was not associated with surf on the Great Lakes—that surf appeared only with on-shore winds and involved relatively warm water. Dr. Forrest Shreve read a paper entitled "Vertical Gradients of Evaporation and Soil Moisture in Desert and Coastal Mountains." He emphasized the point that in coastal mountains the physical conditions were more severe with increase of elevation, while the opposite is true of desert mountains. He solicited the coöperation of other investigators in obtaining similar data elsewhere. Dr. Shreve finds that soil moisture and evaporation conditions rather than rainfall are the vegetal determinants in the Southwest.

A general review of the work of the non-magnetic yacht *Carnegie* was given by Dr. L. A. Bauer in a paper entitled "The Status of the General Magnetic Survey of the Earth." The path of the *Carnegie* as well as the records of land explorers were represented, and the interesting point made that the total length of the *Carnegie's* cruises represents a distance equal to that from the earth to the moon and 100,000 miles beyond.

Prof. R. S. Holway's paper on "Stream and Ocean Terraces in Relation to Recent Earth Movements" was illustrated with unusually clear photographs of the terraced coast of California and dealt with detailed comparative measurements of stream and ocean terraces. The principal technical refinement was the allowance made for the obscuring effects of gravel deposits. The chief point in Prof. W. H. Hobbs' paper, "A Significant Contrast between the Atlantic and Pacific Regions" was the unequal ratio of crustal uplift between the Pacific and the Atlantic, a ratio tentatively estimated at 15:1. In connection with his coastal profiles Professor Hobbs exhibited Barrell's diagram of the broad and now dissected marine terraces of southern New England as published in the *American Journal of Science* (Pl. V, June, 1920). It is Professor Hobbs' view that the rise of the Pacific coastal terraces is caused by underthrust in the coastal belt originated by the downdropping of the Pacific Ocean floor.

Two papers, one by Mr. O. E. Baker on "The Importance and Permanence of the Physical Factors in Determining the Utilization of Land for Agricultural and Forest Production," and the other by Prof. C. O. Sauer on "Problems of Land Classification," illustrate the scope of the work now going forward in soil geography and in the geography of land classification. Miss Zonia Baber, through the medium of excellent diagrams, made a very clear presentation of the mathematical relations of the "Distribution of Sunlight and Moonlight over the Earth." In addition to their educational appeal the diagrams brought out the amelioration of the Arctic night afforded by moonlight.

Prof. Mark Jefferson's paper, "Chile: A Land where Immigrants Need not Apply," was undoubtedly the most brilliant paper of the session. With keen insight into the human conditions and reactions, and with rare judgment in the handling of the facts, Professor Jefferson traced in a masterly way the geographical conditions of German settlement in Chile. In preparation for his main point he emphasized particularly the high density of

population and high productivity per unit of area of cereals, potatoes, etc., as compared with the Argentine, the United States, and France, of that part of Chile *where most of the people actually live*, which is a very tiny section lying principally between Concepción and Valparaiso. This concludes the review of the principal papers during the Thursday sessions.

On Friday the session was opened by Dr. D. T. MacDougall's paper on "The Relation of Plants to New Habitats," in which the author gave his methods and results in transplanting a large number of species from high mountain slopes to lowland localities and vice versa. Some of the transplanted forms are then returned to their original habitat to see what manners, customs, and other special characteristics they retain after their trip abroad. The author referred to Bonnier's classic paper on the transplanting of alpine forms to lowland localities and criticized Bonnier's method, which consisted in part of the actual transplantation of the soils in which the plants grew. Dr. MacDougall felt that this implied a false exactness, since soils are not definite quantities that form a fixed habitat, but are in every case a reaction in part to climate, soil organisms, etc.

One of the most interesting papers on the program was "Ecology and Geographic Boundaries," by Prof. H. C. Cowles, who sketched the ecologic basis of the disputes in the sunk lands region of eastern Arkansas affected by the New Madrid earthquakes of 1811–1812. The paper clearly demonstrated the great progress made in recent years in the study of the physiographic conditions that affect rings of growth and the variation in ring habit among different kinds of trees. Temperature, light, and rainfall all produce a composite effect, and rain does not always have its chief effect in the years in which it falls. The author referred to the importance of ecological studies in decisions bearing on the validity of titles to timber lands and oil fields, and on the present standing of ecology in decisions in the Land Office and the courts. The use of rings of growth is most striking in the case of surveyors' records cut into the trees at the time the surveys were made, and overgrown by new tissue which forms very definite casts of the surveyors' record, well preserved even long after the original record has disappeared by decay. By counting the number of rings since the tree was blazed and the cast made, the original date of survey may be checked or even determined.

Dr. V. C. Finch gave a paper entitled "The Significance of Vegetable Oils in the Economic Development of the Tropics," in which he pointed out the increasing American demand, as well as world demand, for vegetable oils now in use, and of which a considerable number are produced in the temperate zone in competition with temperate crops. The tropical oils are not in such competition with local production. While the demand has increased production, yet if the oil products of the temperate zone are crowded out or limited the question arises, can the tropics meet the demand? The interrelations of climatic and economic factors such as transportation, labor circumstances, topography and soils were indicated. The author concluded that if any crops are likely to succeed in the tropics it would be tree crops under a plantation system of management, because the only limiting factor there is that of market. There are no geographic factors in the tropics to prevent an indefinite increase.

Prof. R. E. Dodge read a paper entitled "Geographic Factors in Dairy Farming in Southern New England." After a preliminary statement of the general problem, there followed a detailed description of conditions in the town of Goshen, 1300 feet above sea level, west of Naugatuck Valley. He compared the conditions of 1845 with those of 1915–1917 in agriculture and dairying. Agricultural and livestock products have fallen off greatly and dairying and poultry products have come in as the cash products of the farm. By these processes the New England farmer has freed himself from bondage to the West. There is still a great difference in local conditions, prices, etc., among different communities that have not yet been brought within the scope of the organized system of market supply involving the large cities. Prof. C. O. Sauer gave a second paper in which he discussed the question of regional economics, of commercial production, and of the movements and commodities of trade. He analyzed the meaning of location in the economic sense, human adjustments to outworn economic conditions, and the value of type studies as illustrations. He raised the question as to what constitutes a geographical map and pointed out that the study of rural areas in-

volves a technique of which we are at present ignorant. How are cities to be studied? What is the proper definition of agricultural geography? He referred to the Dutch agricultural census arranged by geographical divisions.

In "The Grain Trade of Ancient Athens" Miss E. C. Semple gave a most valuable account of the close dependence of Greek material life upon imported food supplies, chiefly grain from the northern border of the Black Sea. The result was an anxious outlook upon forces that threatened her sea power and the security of the sea lanes, particularly the Hellespont.

On Friday evening, December 31, the Geographic Society of Chicago very hospitably entertained the members of the Association of American Geographers at a dinner at the Hotel Sherman. President Harry P. Pearsons of the Geographic Society of Chicago presided and Prof. R. D. Salisbury of the University of Chicago was toastmaster. After the dinner brief addresses were given by the following: Prof. H. E. Gregory of Yale University, "Geography and Good Fellowship;" Prof. C. O. Sauer of the University of Michigan, "The Association and the Isolated Geographer;" Dr. Isaiah Bowman of the American Geographical Society, "Political Geography in the Field of Diplomacy;" Prof. H. H. Barrows of the University of Chicago, "Geography and Legislation."

In Saturday's session there were given a group of papers dealing principally with the geographic conditions of a number of well-marked regions. Mr. F. W. Frostic discussed the history of settlement and the economic development of the Saginaw Valley region. The Fisheries of the Far East, their present low state of development, and the opportunities for American capital were discussed by Prof. F. J. Novakovsky. Prof. R. H. Whitbeck read a paper on the geography of Cuba, emphasizing the advantages of American influence and the probable relapse into disorder if the Cuban people were left to their own devices. Prof. N. A. Bengtson described the physiography and present economic condition of Honduras. Mr. H. C. McMurry explained the retarded development of Nashville which he ascribed to the fact that it is the focus of a small region, the central Tennessee basin; and that other potential regions outside the region are tributary to other foci—Memphis, Louisville, Cincinnati, and Birmingham. In discussion Mr. O. E. Baker justified the view that Nashville is the Athens of the South, by saying that it is the second city in the United States (after Boston-Cambridge) in the number of persons mentioned in Who's Who.

After these regional papers Mr. W. L. G. Joerg gave an account of "Bering's Two Expeditions to Determine the Relation of America to Asia." Mr. Joerg described Bering's first and second expeditions which were in the field from 1725 to 1730, and 1733 to 1741 respectively. His paper was illustrated by two wall maps, one giving a modern interpretation of the land and sea route of Bering's first expedition, the other representing a reconstruction by Bertholf of the tracks of the *St. Peter* (Bering) and the *St. Paul* (Chirikov) on the second expedition.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

The General and Technical Meetings. On December 14th at 8:30 P. M. Baron de Geer addressed the Society on the subject of "Geochronology and its Application to Physical Geography." It was the first of a series of special lectures to be given during the winter season at the Society's building, Broadway at 156th Street. These lectures will be of a more technical nature, affording opportunity for the exhibition of appropriate illustrative material and taking the place of the former intermonthly meetings held at the Engineering Societies' Building, 29 West 39th Street. The regular monthly meetings of the Society will be held as usual in the auditorium of the Engineering Societies' Building and will retain their character of general interest.

Mr. Roy C. Andrews, of the American Museum of Natural History, opened the lecture program for the year on November 23, 1920. On December 21 Dr. Alexander Hamilton Rice gave the second lecture. In January the Society will hear Mr. Robert Cushman Murphy, of the Brooklyn Museum. His lecture is entitled "The Humboldt Current and the Islands of Peru." In February Professor Robert F. Griggs, of Ohio State University, will deliver an illustrated lecture on Katmai Volcano, Alaska. Announcement will be made at a later time of the remaining lectures to be given in March and April.

Address by Baron Gerard de Geer on Post-Glacial Chronology. Baron Gerard de Geer is Professor of Geology at the University of Stockholm. He has just concluded a visit to North America for the purpose of supplementing his extensive studies of Scandinavia and Spitsbergen in the field of post-glacial chronology. By a detailed study of the laminae of clay beds deposited in fresh water, Professor de Geer was able to discover seasonal effects, so that he could count the years during which the deposit had been made. Thus by a careful selection of localities and by matching variations in widely separated deposits, he was able to piece together the post-glacial record, including the retreatal stages of the ice sheet in Scandinavia. Professor de Geer then carried his studies into Spitsbergen, where they took on a somewhat different form; and with the help of an assistant he has studied deposits in northeastern North America in an effort to correlate the chief historical events of the late-glacial and post-glacial epochs with the events of similar epochs in Scandinavia.

The results are in every way gratifying. The correspondences are quite convincing, and there is thus held out the prospect that a more detailed and far more reliable chronology than existed hitherto may be worked out. Not the least interesting of Baron de Geer's observations was the one dealing with the possibility of correlating the latter part of the clay record with the earlier part of the tree record discovered by Professor Douglass and later worked out in great detail by Professor Huntington in Carnegie Institution Publication No. 192. It would be an extremely interesting thing to match the clay record of a recent period with the record of the rings of growth of the trees of the latest period, thus providing a complete chronology from late glacial times right into the present. This introduction of the time factor has a wide application in the field of physical geography. Where the recession of the former ice sheet has been determined the rate of evolutionary processes can be established. For instance it has been shown that in central Scandinavia the land has been uplifted some 900 feet in the last 8,500 years at a decreasing rate that has been determined century by century. At the same time the changes in the rate of melting of the ice afford a most remarkable register of the annual variation in the amount of heat received from the sun, thus extending the field of investigation of climatic evolution from terrestrial to astrophysical causes.

Presentation of the David Livingstone Centenary Medal to Dr. Alexander Hamilton Rice and Lecture by Dr. Rice. Dr. Rice's lecture dealt with his latest journey up the Rio Negro, through the Casiquiare Canal, and the upper waters of the Orinoco. Before the lecture Dr. Rice was presented the David Livingstone Centenary Medal, founded by the Hispanic Society of America and awarded by the American Geographical Society. Dr. Rice is the sixth recipient of the medal, the earlier recipients being Sir Douglas Mawson,

Theodore Roosevelt, Manuel Vicente Ballivián, Candido Mariano da Silva Rondon, and William Speirs Bruce. In presenting the medal President Greenough spoke as follows:

"It is now my pleasing duty as your President to bestow your gold medal upon a most worthy recipient. The resolution of award by the Council reads as follows:

TO
ALEXANDER HAMILTON RICE
1920

> Specially equipped for pioneer work in exploration he chose for his field various tributaries of the Amazon, hitherto unknown. In six successive journeys he surveyed large portions of the Rio Negro; the Solimões, the Uaupes, the Içana, and Iniridi, the Casiquiare Canal, and the Upper Orinoco. He has also maintained a school at São Gabriel for the education of the natives and devoted himself to a fundamental understanding of the life of northwestern Amazonas.

"This brief text serves as an index to the extensive and valuable services which the explorer has rendered to geographical science. When we realize that the Amazon Valley has 30,000 miles of navigable waterway, we can appreciate that many of these are still a sealed book to civilized mankind. Our guest has not only defined the great watercourses of the unknown regions which he visited, but he has investigated thoroughly the adjacent country, its topography, and its native population. The perils of such adventures are illustrated in the case of our lamented colleague the late Colonel Roosevelt, whose life was undoubtedly shortened by illness contracted in his journey down one of the tributaries of the great river.

"All the data acquired on his expeditions have been reduced by Dr. Rice to complete scientific order and record, thus rendering them available for further research; and he has pursued his important work with modest devotion to his quest, free from any public exploitation or advertisement. Such a bearing adds to the satisfaction which the Society may well feel in according suitable recognition to a notable accomplishment.

"And now, Sir, on behalf of the Society I ask your acceptance of this memorial of your distinguished efforts in the past, accompanied by the good wishes of all our Fellows for your welfare and success in your future undertakings."

After explaining his methods of survey in northwestern Amazonas, where he has explored a large region during the past thirteen years, Dr. Rice described the difficulties of the journey up the headwaters of the Rio Negro to the Casiquiare Canal, illustrating his description with many slides depicting the life of the natives. After a description of the Canal, which connects the headwaters of the Rio Negro and the Orinoco, Dr. Rice came to the climax of his account—the attack by savages upon his camp on the Orinoco east of the Canal. He was obliged to keep up a running fight with them for some hours and was lucky enough to escape with his life. The incident required him to leave incomplete a part of the original program.

NORTH AMERICA

The Population of Porto Rico. A preliminary bulletin issued by the Fourteenth Census (1920) shows that the total population of Porto Rico has increased from 1,118,012 in 1910 to 1,297,772 in 1920 or at a rate (16.1 per cent) corresponding very closely to the rate for the preceding decade. Though on the whole this increase has progressed with fair uniformity throughout the larger part of the island, it is more noticeable in the area lying south of and tributary to San Juan than elsewhere. The density of population is 325.5 per square mile, the equivalent of that of a large portion of the Po valley. If the present rate of increase keeps up, the problem of over-population is likely to become even more and more serious in the future. (F. K. Fleagle: Social Problems in Porto Rico, 1917.)

Visitors have often observed that the population is distributed with remarkable evenness over almost the entire surface of the island. Except for San Juan with 70,707 inhabitants and Ponce with 41,561, there are no towns of over 20,000 and the majority of the people dwell in the open country. Only 21.8 per cent live in towns or villages of more than 2,500, and 73.5 per cent live in rural districts not a part of any village. Nor has there been any appreciable displacement of the people from country to town. Between 1899 and 1910, probably as an immediate result of the American occupation, the proportion of town to

country dwellers rose from 14.6 per cent to 20.1 per cent, or 5.5 per cent of the total; but in the last decade urban centers of over 2,500 gained only 2 per cent.

SOUTH AMERICA

The Patagonian Forests. The Patagonian forests extending from latitude 33° S. (in the coastal mountains of Chile) to latitude 55° S. (Cape Horn), a distance of some 1,500 miles, form the subject of a report published by the Argentine Ministry of Agriculture (Max. Rothkugel: Los Bosques Patagonicos, Buenos Aires, 1916).

This long but narrow region is divided into three subregions: (1) Humid (rain) forests with many species, (2) humid (rain) forests with few species, (3) pure forests to the east and north of the humid forests.

The humid forests with many species extend from latitude 38° S. (near Victoria, Chile) to latitude 48° S. (mouth of Rio Baker). The region has a rainfall of between 80 and 120 inches and lies west of the axis of the Andes mostly on the Chilean side, though, mainly because the boundary line between Chile and Argentina does not coincide with the watershed, patches of the forests extend into Argentina. While the climate of this region varies according to latitude and altitude, it is generally mild with little or no snow or frost on the coast and with a fairly equable temperature throughout the year. At higher altitudes, where the forest occurs in the valleys, the climate is of course more severe. Nevertheless the conditions are such that the forest consists of a mixture of many species with an undergrowth that suggests subtropical rather than "antarctic" conditions, as is suggested by the designation often applied to the floral region of the Patagonian forests (Griesbach). Indeed one author, Warming, classified it as "subtropical," and Schimper calls it a "temperate rain forest." The principal trees of the region are the evergreen beeches (*Nothofagus*) and certain conifers (*Libocedrus*, *Fitzroya*, *Podocarpus*, and *Saxegothea*). The principal commercial timbers are *roble* (*Nothofagus obliqua*), *rauli* (*Nothofagus procera*), *coihue* (*Nothofagus Dombeyi*), *cipres* (*Libocedrus chilensis*), *alerce* (*Fitzroya patagonica*), and others.

The northern part of the forest region in Chile has been mostly cut over by the lumbermen and for agricultural purposes.

The humid forests with few species lie from south latitude 48° to Cape Horn. This region has a colder climate than the region to the north, with generally the same rainfall conditions. The index species of this region is *guindo* (*Nothofagus betuloides*) mixed with others, though the composition of the forest is not so complex. It has undergrowth species.

The pure forests extend in a narrow belt mostly on the Argentina side from Tierra del Fuego to the northern part of the territory of Neuquén, a distance of 1,100 miles. Here the characteristic species are *lengue* (*Nothofagus pumila*) and *ñire* (*Nothofagus antarctica*), usually occurring in almost pure stands. In Chile the region continues north of the humid region in the high valleys of the Andes, to 35° S. latitude and in the coastal mountains to 33° S. latitude. Besides *ñire* and *lengue* these forests contain roble. The pure forests are the expression of a drier climate and grade off into the non-forested regions of the east and north. In Argentina at the south they are found from sea level to 2,000 feet altitude and at the north from 4,000 to 6,000 feet altitude.

The subregion of the Chilean pine (*Araucaria imbricata*), known in Argentina as *pino de Neuquén*, lies in the Andes well to the north, from near 37° S. latitude to about 40° S. latitude, with a detached area in the Nahualbuta section of the coastal mountains of Chile between 37° and 38° S. latitude. There are two types of this; one pure, lying mostly on the Argentina side, and one mixed with other species, mostly in Chile. In Argentina the altitudinal range of the Chilean pine is from 2,100 feet above sea level at 40° S. latitude to about 6,000 feet at 37° S. latitude. The Argentina portion of the Araucarian forest covers some 200,000 acres, and is very inaccessible at the present time.

The Patagonian forest area of Argentina (with which the report is primarily concerned), covering nearly 10,000 square miles of intact forest, has no commercial value at present. But the forest is highly important as a protective cover. As Bailey Willis (Northern Patagonia) has shown, some of the adjacent semidesert land is susceptible of irrigation with the proper protection of the forested watersheds. If properly managed it would do this and be able to furnish continuous crops of timber for the inhabitants of the country. Steps have been taken by the Argentine government for the protection of the forests, and the introduction of economically valuable species of trees is being considered.

H. N. Whitford

EUROPE

The Italian-Yugo-Slav Boundary and the Free State of Fiume. The treaty of Rapallo (Rapallo is a few miles east of Genoa) signed November 10 establishes the boundary between Italy and the Serb-Croat-Slovene Kingdom and creates the Free State of Fiume. The text of the treaty is published in *Il Messaggero* for November 13, 1920.

Italy gains practically her maximum demands in the "irredenta" of Julian Venetia (see the review of Tamaro's "La Vénétie Julienne" on p. 153). The treaty of London line has here been the base of further concessions. This line it will be recalled ran from Mt. Tarvis along the watershed (Julian Alps) between the Isonzo and Save basins to the pass of Idria (leaving the famous mercury mines in Italian territory), thence across the forealpine and karst country towards the Schneeberg (Mt. Nevoso) "in such a way as not to include the basin of the Save and its tributaries in Italian territory," thence to the head of the Quarnero west of Fiume. The accompanying map shows the deviations from this line. Italy acquires the town of Tarvis (a strategic point commanding routes northeast to the Drave, west over the Saifnitz (Camporosso) pass to the Tagliamento and south over the Predil pass to the Isonzo. East and south of Idria Italy gains a considerable territory including the town of Adelsberg whereby the frontier is pushed well towards Laibach. From the eastern slopes of the Schneeberg the line swings southwestwards to meet the northern boundary of the Free State of Fiume a short distance southwest of Castua. Of Istrian territory Italy also acquires the islands of Cherzo and Lussin and the small islands and rocks included in their judicial districts.

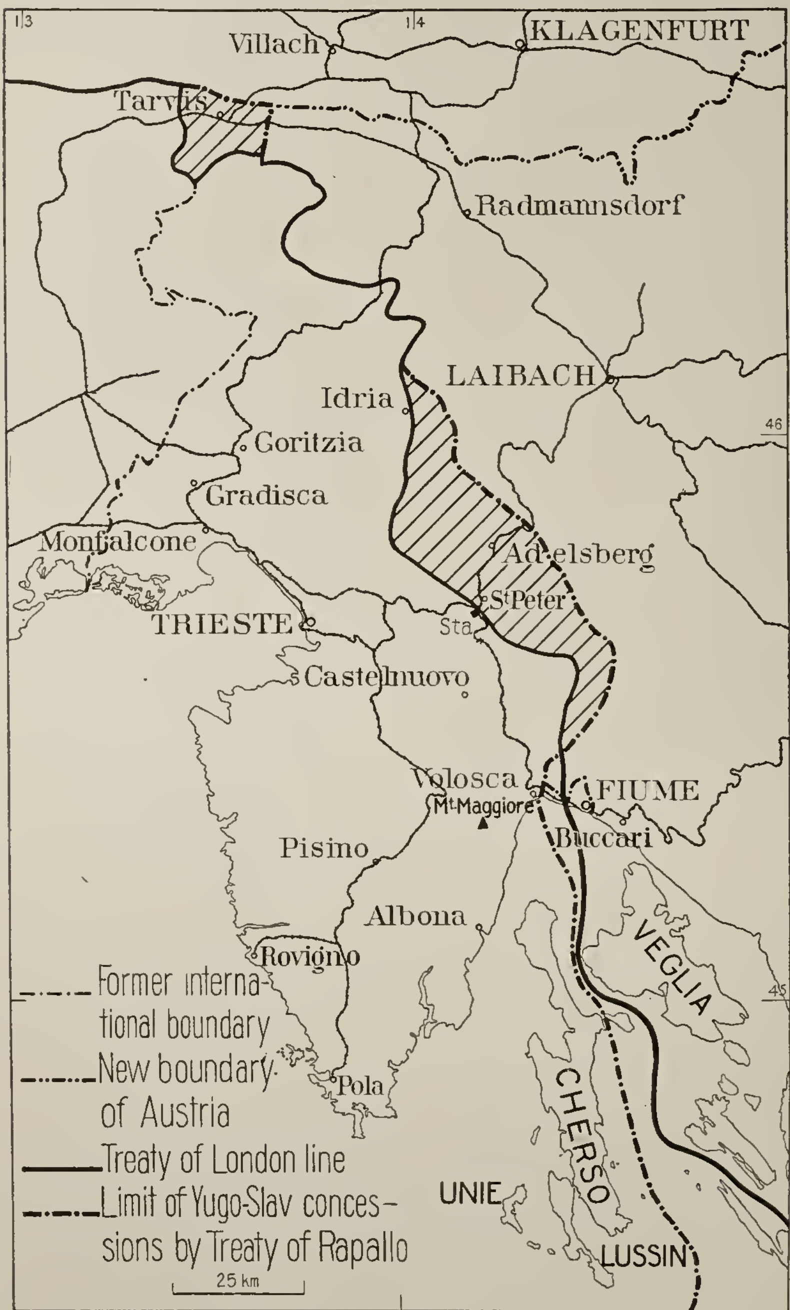

FIG. 1—The boundary between Italy and the Serb-Croat-Slovene Kingdom according to the Treaty of Rapallo.

Italian sovereignty in Dalmatia is limited to a territory about Zara including the city and the fiscal commune, the adjoining fiscal communes of Borgo Erizzo, Cerno, Boccagnazzo and a part of Diclo. Special arrangements will be made to provide for reciprocal relations between this territory and the rest of the territory formerly belonging to the "commune, district and province." This will include equal division of the provincial and communal property and archives.

The islands of Lagosta and Pelagosa with the adjacent islets go to Italy. All the other Dalmatian islands are recognized as forming part of the Serb-Croat-Slovene Kingdom.

The State of Fiume is recognized as independent. It comprises the "corpus separatum"

delimited by the boundaries of the city and district of Fiume and a strip of former Istrian territory along the Gulf of Fiume. This strip which averages a kilometer and a half in width provides an unbroken route from the free city to contiguous Italian territory, one of the prime conditions of the Italian diplomatic program ever since the summer of 1919.

Natural Political Divisions of the Scandinavian Countries. The general tendency to reconstruction, resulting from the war, has found an expression in many of the European countries in the desire for internal political and economic readjustment. In the *Geographical Review*, Vol. 7, 1919, pp. 114–118, various proposals for changing existing administrative subdivisions, notably those of England, France, and Germany, were discussed. In line with this general tendency is Professor Sten de Geer's suggestion, developed in an article in *Ymer*, which contemplates the redistribution of the subdivisions of Fenno-Scandia and Denmark in general and of Sweden in detail.

The proposed plan reduces to eight the present twenty-five provinces of Sweden. The proposed provinces are founded upon geomorphological, hydrographic, and climatic bases with due regard for biogeographic and anthropogeographic factors, a consideration of their historical development and the groupings of population. They are units of production, transportation, and commerce; and as a rule they have about equal population. That the boundaries of these provinces cannot conform to all factors is evident, but the transgressions of any one determining factor upon another are remarkably few and relatively insignificant.

Fig. 1—Proposed political divisions of the Scandinavian countries. Reproduced from the article abstracted in the text.

By Professor de Geer's proposed division, Öfvernorrland and Nedernorrland comprise the northern and southern halves of the northern third of Sweden; Bergslagen and Mälarelandet, the western and eastern halves of central Sweden; Västkustlandet, Östkustlandet, and Skåne, comprise the southern portion; and Gottland becomes a distinct island province despite the rather close relation to the neighboring mainland.

The five southern provinces are fundamentally based upon distinct geomorphological characteristics. The three northern provinces are comprised within the sharply defined physiographic unit, Norrland, which is geomorphologically and biogeographically a distinct area. The southern boundary of Norrland is the northern limit of the oak, fruit trees, and pure agriculture; it is the southern limit of heavy snow, arctic winter, and lumbering. Delimitation of the provinces is largely determined by the watersheds.

The provinces thus defined are readily adaptable to the needs of administrative control. In this connection De Geer discusses them in relation to judicial, ecclesiastic, and military government, and argues for the relatively slight changes which his proposed system would necessitate. Though these changes would benefit both the judiciary and the church somewhat, it is the military strength of the nation which would best be served and promoted, particularly if the man power of each new province be duly considered. The final argument for the proposed subdivisions is based upon economic factors. The postal service, the railway systems, and movements of trade accord well with the new system.

The possibilities for the establishment of like rational provinces in the neighboring Scandinavian countries are briefly discussed. In Norway such a subdivision is readily established and easily justified. Norway is subdivided into the six provinces; Nordlandet, Tröndelagen, Västlandet, and the three districts—Oplandet, Kristianialandet, and Sörlandet—of Östlandet. Of these the three first named front upon the Atlantic and are definite natural divisions. They vary considerably in population but yet not so much so that serious objection may be raised on this ground. The three districts of Östlandet are a natural gemorphological unit, but because if united they contain over half the population of Norway, their retention as subdivisions is considered desirable.

These subdivisions of Norway accord very well with those proposed for Sweden: Nordlandet corresponds to Öfvernorrland naturally and culturally; the southern boundary of one is a continuation of the southern boundary of the other. The two provinces are connected by railway from Luleå to Narvik. Similarly, Trondelagan corresponds to Nedernorrland. These divisions are connected by railway from Sundsvall, in Nedernorrland, to Trondjhem. Oplandet in Norway corresponds to Bergslagen in Sweden. These two provinces lack seacoast, the only provinces in Scandinavia which do not front salt water. Further correspondence between the subdivisions of the two countries may be found in Kristianialandet and Sörlandet to Västkustlandet, and in Västlandet to Östkustlandet. These southern provinces are connected by railway and are industrially analogous.

FIG. 1—Proposed geographic regions of Sweden. Reproduced from the article abstracted in the text.

Finland is divided into Nordfinland, similar to the northern provinces of Norway and Sweden; Sydfinland, roughly accordant with the southern provinces of the peninsula; and an inland province, Sjölandet, the great lake district of Finland, which may be compared with the lake district of Sweden, though the latter is not defined as a province.

Denmark must be subdivided on the basis of factors quite different from those considered in the rest of Scandinavia. Two principal divisions at once suggest themselves—the peninsula Jylland (Jutland) and the islands. Jylland may tentatively be divided into three natural divisions, Väst-Jylland, Nord-Jylland, and Öst-Jylland distinguished by different soils and different culture and comparing favorably as regards population; but such a subdivision De Geer considers merely experimental. The islands may again be divided into distinct groups—the Eyn group, the Sjaelland group, and Bornholm.

W. ELMER EKBLAW

The Geographical Subdivision of Sweden: A Study in Urban Geography. The proposed subdivision of the Scandinavian countries abstracted above from *Ymer* has provoked further discussion. In the succeeding number of *Ymer* (No. 4, 1918) Dr. Helge Nelson raises the argument that De Geer's standpoint is in reality administrative rather than geographic and that his subdivisions are essentially historical-administrative in character. Dr. Nelson's own proposal is of a more radical nature. His thesis is expounded at greater length in the recent *Festskrift* volume of Lund University (*Lunds Universitets arsskrift*, N.F. Avd. 1, Vol. 14, 1918) in the article "Geografiska studier

over de svenska stadernas och stadslika orternas lage," of which a useful summary and review is given by John Frodin in *Geografiska Annaler*, Volume 1, 1919, pp. 400–404.

The primary idea back of the new subdivision is "to define the relationship between man's culture and his environment and to express man's reaction to his habitat and his influence upon his habitat. The basis for such subdivision is to be sought not in the separate natural elements, topography, hydrography, vegetation, etc., nor in an attempted reconciliation of them but in some composite culture factor. The facts of human settlement afford this criterion, more particularly the concentrated grouping—towns and town-like agglomerations. As Jefferson says, "The grouping of these human foci would sketch for us the actual geographic provinces of the earth, not physiographic, not geologic, not climatic, nor yet political, but geographic as showing man on the actual earth in the play of varied forces." In such a view of course the urban unit is considered in relation to the surrounding country. It is regarded as "an organism which has grown out of the landscape to which it belongs as a natural exponent thereof." Furthermore the character of the town is "an expression of different factors which have been at work during the different stages of development."

From this standpoint the author arrives at the subdivision of Sweden into the following geographical regions:

I. The Mountain Region: 65,000 square kilometers with 28,000 inhabitants (0.4 per sq. km.). The single urban center owes its existence to purely local circumstances.

II. The North Swedish Woodland: 138,000 sq. km. with 290,000 inhabitants (2 per sq. km.) of whom 4 per cent live in urban communities.

III. The North Swedish Silurian Region: 13,800 sq. km. with 80,000 inhabitants (5.8 per sq. km.) of whom 17 per cent are urban. The towns are commercial centers. The significance of the calcareous element of the soils of the silurian rocks has frequently been pointed out (see Rabot: La distribution de la population en Suède en fonction de la constitution géologique du sol *La Géographie*, Vol. 11, 1905, pp. 359–367).

IV. The North Swedish Coastal Region: 52,200 sq. km. with 621,000 inhabitants (12 per sq. km.) of whom 19 per cent are urban. There is a line of older towns at the head of river navigation; a group of outposts dependent on the sawmills; a series of industrial and railroad centers.

V. The Gästrikland (South) Dalarne Region: 8,700 sq. km. with 240,000 inhabitants (28 per sq. km.) of whom 40 per cent are urban. The towns are mining and manufacturing centers.

VI. Bergslagen: 8,100 sq. km. with 131,000 inhabitants (15 per sq. km.) of whom 23 per cent are urban.

VII. The Central Swedish Plain and Fault Region: 65,100 sq. km. with 2,506,000 inhabitants (39 per sq. km.) of whom 47 per cent are urban. In subprovince 1, the Mälar country, the ratio of urban (55 per cent) to rural population rises highest. The towns of the eastern coast are typically medieval trading centers at the heads of the bays. On the west they are often fishing centers, while the large lakes have fixed the positions of many towns in this region.

VIII. The South Swedish Uplands: 45,800 sq. km. with 1,060,000 inhabitants (23 per sq. km.) of whom 22 per cent are urban. There are coast towns on good harbors, but no less than 33 of the 45 urban communities are in the interior. Many have come into existence during recent years at points where the railroads intersect old traffic lines.

IX. The Scanian Horst and Plains Region: 9,300 sq. km. with 673,000 inhabitants (72 per sq. km.). Of the population of the Horst only 3.3 per cent is urban. In the southwestern plain the percentage rises to 49; on the Kristianstad plain to 30.

X. The great Baltic Islands, Gottland and Oland. Each possesses one town.

ASIA

Climatic Zones of Japan and Formosa. A zonal classification of the climate of Japan and Formosa is given by Miss E. M. Sanders in the July, 1920, number of the *Monthly Weather Review*. In Japan proper three major climatic zones are recognized based upon the isotherms for January—northern (north of the 32° F. line), central (between 32° and 40° F.), southern (south of 40° F.). The first two zones are susceptible of division each into two types.

In the northern zone the Nemuro type includes the greater part of the island of Hokkaido. It exhibits an extreme temperature anomaly. The average winter temperature is every-

where below 20° F.; the summer temperature ranges between 60° and 70° F. The anomaly is more marked than in the case of Newfoundland with which Hokkaido is commonly compared as regards climate. The rainfall is scanty, less than 20 inches, and is marked by a September maximum (see graph of Abashiri, Fig. 9, p. 27). Southwards temperatures become less extreme and rainfall increases. The Hakodate type includes besides southern and western Hokkaido a part of the main island (see graph of Suttsu, p. 27). The central zone is subdivided into eastern and western types primarily on a basis of seasonal distribution of rainfall. The east has a rainy season in summer, the west in winter. The west is further characterized by greater cloudiness and frequency of fog. As far as the agriculturist is

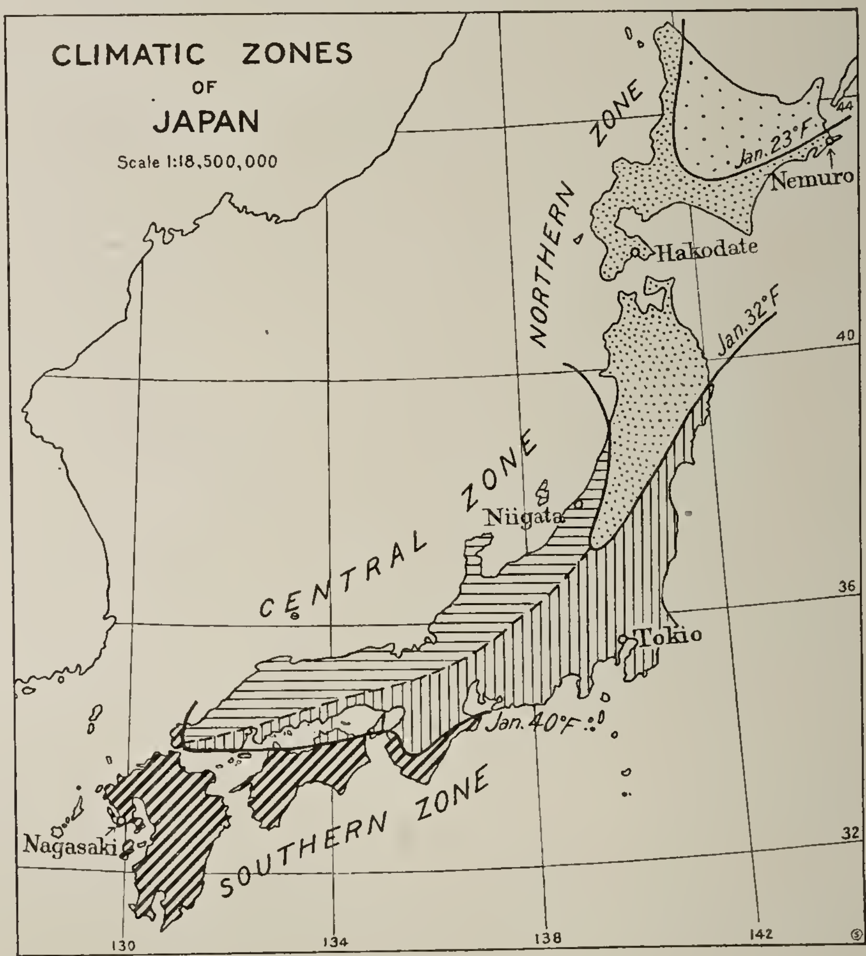

Fig. 1

concerned, the southern part of the central zone is distinguished as a two-crop region—rice in summer and wheat in winter. The southern zone is semitropical, and three crops a year can be raised. The winter temperature is low for the latitude, but the summers with high temperatures and great humidity are enervating.

Formosa on the northern tropic has a typical two-season monsoon climate. The winter monsoon brings heavy rainfall to the north and east of the island. Kashoryo on an eastern hillside has the reputation of being one of the wettest places (289 inches a year) in the Far East. The southwest monsoon brings lighter rains, but the typhoons which prevail during the summer are responsible for abnormal rainfalls.

HISTORY OF GEOGRAPHY AND EXPLORATION

The Farthest Points reached by Bartholomeu Dias. The identification of places visited by early navigators has always raised difficulties. We are familiar in America with discussions about the place where Leif Eriksen built his house in Vinland or as to whether Columbus' first landfall was Watling or Cat or Great Turk or some other island. Of a similarly controversial nature is the problem of the farthest points reached by Bartholomeu Dias on the famous voyage of 1487–1488 during which he discovered the Cape of Good Hope

and about which Canon E. B. Ford has set forth some new theories in a paper recently read before the South African Association for the Advancement of Science (*South African Journ. of Sci.*, March, 1920, pp. 345–364).

The commonly accepted narrative of Dias' voyage is found in De Barros' "Asia," an elaborate and pretentious, though not entirely reliable, work written some sixty years later. From a detailed study of more nearly contemporary sources—particularly certain old maps and the *roteiro*, or diary, kept during the expedition of Vasco da Gama—as well as from an extended personal examination of the ground, Canon Ford has come to the conclusion, among other things, that De Barros was mistaken in saying that the last *padrão*, or stone monument, set up by Dias, was on the island of Santa Cruz in Algoa Bay, although the navigator may well have built a wooden cross at this point. He believes that the *padrão* in question, which was dedicated to San Gregorio, was probably erected at Kwaiihoek, or False Islet, on the mainland to the east. Of greater general interest, however, is the determination of the exact point at which Dias, overcome by the objections of his officers and forced to abandon his ambitious project of pushing on to the Indies, finally put about and headed for home. Canon Ford rejects the long accepted identification of the small river which marked this point, and which was named by Dias "Rio do Infante," with the Great Fish River and favors instead the Keiskama some twenty miles farther east. The latter is at a distance which accords far better with the figure given in the *roteiro* for the stretch between the *padrao* and the Rio do Infante than does the shorter distance between the supposed position of the *padrão* and the Great Fish.

In connection with the date of Dias' voyage, Ravenstein in an article in the *Geographical Journal* for 1900 showed that De Barros was wrong when he placed it in 1486–1487 instead of 1487–1488. As the names given to places along the coast were in many instances taken from the church calendar and bestowed on the days during which the various localities were passed, it is possible for us to gain some idea of the chronology of the voyage from the maps drawn to illustrate it; and, indeed, Canon Ford suggests that "the names given by Dias are well worthy of a more extended study."

PHYSICAL GEOGRAPHY

The Recording of Nighttime Cloudiness. Professor R. DeC. Ward's recent discussion of "Cloudiness in the United States" (*Geogr. Rev.*, Vol. 9, 1920, pp. 347–356), concerns daytime observations of sky cover and duration of sunshine but not nighttime cloud conditions: for practically no records of nighttime cloudiness are available. Eye observations of cloudiness are made hourly at the central office of the U. S. Weather Bureau by watchmen, and irregularly at other Weather Bureau stations. Some astronomical observatories also keep records of night cloudiness. The only automatic records of night cloudiness made in the United States are taken at Blue Hill Observatory (Harvard University) and at the University of Chicago station of the U. S. Weather Bureau. The instruments used are modified Pickering Pole-Star (photographic) recorders. The apparatus at Chicago was only recently installed (described in *Monthly Weather Rev.*, Mar., 1919, Vol. 47, pp. 154–156). A similar night cloudiness recorder has recently been brought into use at the Royal Observatory, Greenwich (described and discussed in *Quart. Journ. Royal Meteorol. Soc., July, 1920*, Vol. 46, 1920, pp. 243–244). In view of the blanketing effect of clouds on nocturnal cooling, night cloudiness is worthy of close observation, especially where there are fruits or other crops subject to frost damage.

CHARLES F. BROOKS

GEOGRAPHICAL REVIEWS

The Development of Argentina

Pierre Denis. **La république Argentine: La mise en valeur du pays.** 299 pp.; maps, bibliogr. Armand Colin, Paris, 1920. 14 fr. 9 x 5½ inches.

Scholarly geographical works on South America are few, and the appearance of a volume on the Argentine by the author of "Brazil" in the South American Series will be welcomed by serious students of geography the world over.

The volume is not a systematic regional geography. In his introduction the author points out that such a treatment, while it is the most satisfactory for the long-settled countries of Europe, is not necessarily the best for the Argentine, where one of the salient elements in the geography is still the constant shifting of the population and the transitory nature in any one region of a special type of exploitation. If geographers will accept this and study the work from the viewpoint of the author they will find it fit to take its place beside the best regional studies of Europe. The book has as its subtitle "La mise en valeur du pays," and it partakes in part of the nature of an examination of the economic life of the country and is at the same time an explanatory history of colonization in the Argentine. But, inasmuch as the author is a geographer, there is scarcely a page of the work which does not set forth some leading feature of the varying physical environments which lead to such a variety of economic conditions.

The author's book on Brazil was written for the general and non-technical reader, and yet it contains a most valuable sketch of the geography of that country. The present work is evidently intended for a different public. It presumes a considerable knowledge of the processes and conditions underlying the physical geography. A brief explanatory statement of the physical geography as an introduction might however have been added with advantage.

The work begins with a short chapter on the natural regions and sets forth the leading features of the landscape in each. The close relationship between the details of surface relief and soil on the one hand and climate on the other are well brought out. In this chapter we are introduced to the human responses to these environments throughout the history of the country.

The next two chapters deal respectively with "The Oases of the Northwest and the Pastoral Life in the Scrublands" and "Tucumán and Mendoza, the Great Industrial Cultures." In these two as in subsequent chapters the historical development of local industries and occupations is traced in considerable detail; and the accounts of the actual state of industries throughout the book appear to be so well informed, both as regards technique and labor conditions, that each might have been written by an expert. In these chapters we learn of the three zones of habitation in the northern Cordilleras—the wide *valles*, the narrow *quebradas*, and the *puna*. The account of water resources and of the elaborate and ancient customs regarding their utilization merits careful study. The same is true of the description of the great sugar industry of Tucuman and the anomalous climatic conditions which have made it possible, while the response of the wine industry of Mendoza to physical geography is clearly set forth.

Chapter 4 is entitled "The Exploitation of the Forests, but it includes other aspects of the geography of the two main forest regions—the Chaco with the Paraná valley and the narrow slice of the typically Brazilian forest included in the territory of Misiones. The omission of the southern Andean forests is explained by the statement in the chapter on Patagonia that the chief economic use of these is in the regulation of run-off in connection with the hydraulic schemes of the future. Since the lumbermen of the Chaco forests are largely drawn from the irrigation oases of the *bañados*, further west, the author characteristically opens with a description of the life in these oases, with the emigration in May to Tucumán for sugar work, in October to Córdoba and Santa Fé for agriculture, and throughout the year to the Chaco forest. An interesting contrast is drawn between lumbering, on the one hand, in the interior of the Chaco with its small mobile mills owned by men of small capital and incapable of being worked economically very far from the railways and, on the

other hand, the forest operations near the Paraná carried on entirely by the great tannic acid combines possessed of large capital and owning great factories. The latter draw their labor from the left bank of the river and use the quebracho wood almost entirely for the extraction of the tannin. In this belt the land tends to get into the hands of a smaller number of owners each year, and in the province of Santa Fé the entire forest is divided between two companies. The author expects that the Chaco forest will eventually disappear and give place to cattle ranches.

Of Misiones with its forest life we have a brief but satisfactory picture: the lumbering in the Araucaria woods; the *maté* industry, with its serflike labor, which may be compared to the rubber gathering of the Amazons; and the small agricultural settlements in the clearings.

Chapters 5 and 6, on Patagonia and the Pampas respectively, are perhaps the most satisfactory part of the book from a geographical standpoint. They are much more systematic in their treatment and are so rich in content that they should be carefully read by all geographers. The physical conditions are never lost sight of. In each region they are sufficiently well-known to permit of a subdivision into what are probably the real human geographical provinces, each with its distinct and fairly well-established mode of life. The Pampas chapter is a specially good example of a study of this kind.

Chapter 7 describes the main roads and railways in the Republic, sketching their setting, their development, and the economic basis of their traffic; while Chapter 8 deals with the waterways in similar fashion. In the latter chapter is included a physical description of the Paraná and Uruguay systems which is lucid and thorough. The work concludes with a chapter on the population, its distribution and its movements, the sites and character of the cities, leading up to a sketch of the personality of Buenos Aires.

As we may hope that the work will speedily run into a new edition, it may be useful to point out a fault which can be easily remedied. The maps, seven in number, are insufficient. They were doubtless limited by the cost, but the publisher would be well advised to allow more scope in this matter. To take but two instances: the detailed description of the Paraná, with its changing meanders, and the account of the contours in the pampas are greatly impaired by complete lack of illustration. But the existing maps would be doubly useful if placed at the end of the book so as to fold out, and if references to them were given in the text. There is not a line on these diagrams that is not essential. The work contains an exceedingly useful bibliography with critical annotations.

The British West Indies in Relation to the American Revolution

F. W. Pitman. **The Development of the British West Indies, 1700–1763.** xiv and 495 pp.; map, diagrs., bibliogr., index. (Yale Historical Publications: Studies, IV.) Yale University Press, New Haven, 1917. $2.50. 8½ x 6 inches.

As in most modern wars, economic causes lay back of the American Revolution. Questions of trade were almost as important a factor in bringing about that conflict as were political rights and liberties. The present volume, in addition to treating of the development of social life, the distribution of land holdings, the labor problems encountered, and the financial systems in vogue in the West Indies, presents a carefully detailed account of some of the economic conditions which contributed to the separation of the North American colonies from Great Britain. The work is based chiefly upon manuscripts found in the British Museum and the Public Record Office.

The exchange of commodities between North America and the West Indies Islands figured prominently among these economic factors. These two regions were geographically complementary. In climate and soil, hence in their products, they were sharply contrasted. The typical productions of New England, such as grain, lumber, fish, and horses, together with the limited output of incipient Yankee manufacture, barrel staves, hoops, boards, and shingles, found their nearest and most natural market in the tropical colonies that stretched from the Bermudas to Surinam, while the rapidly growing settlements along the North Atlantic coast offered a ready emporium for a large part of the sugar which was almost the sole product of the West Indies. But this trade, based on geographical dissimilarity of the two regions, refused entirely to recognize the artificial boundaries established by political sovereignty. Such a condition was not at all in keeping with the commercial policies prevailing in Europe; hence England and France, the mother countries most

directly concerned, attempted to restrict colonial trade within the bounds of their own possessions. Here geographical laws of trade clashed with those of political legislation. The latter were largely ignored, and illicit commerce flourished, in spite of attempted enforcement of restrictive measures. None of the legislation, culminating in the "Molasses Act" of 1733, all of which aimed to prevent trade between British colonies and foreign markets, was able to divert commerce from these natural channels which ruthlessly crossed political boundaries.

So strong were these geographical laws of trade that, in spite of all legislation to the contrary, commercial relations between these climatically complementary regions became too deeply entrenched to yield even in times of war. During the Seven Years' War, when the two European powers were in conflict, and even when the conflagration extended to their respective New World possessions, the colonies continued to exchange their wares. Civil and naval measures were alike fruitless. In fact the British colonists, though their royal governors sought to check this trade, were, as a people, thoroughly convinced that their interests lay in maintaining direct commercial relations with their West Indian clients of whatever nationality they might be. Thus entered the wedge which rapidly brought about a complete rupture between the people of the thirteen colonies and the government of the mother country.

Since the one product of the West Indies was sugar (with its by-products of molasses and rum), this history reveals, too, how important a rôle was played by a single commodity in the political relations of the British Empire at that time. Just as cotton, coal, iron, and petroleum have, time and time again, exerted a controlling influence in world politics, so sugar, as an item of international trade, was one of the important factors leading up to the separation of the colonies from England.

The Forest Resources of British Columbia

H. N. Whitford and R. D. Craig. **Forests of British Columbia.** viii and 409 pp.; maps, ills., index. Commission of Conservation, Canada. Ottawa, 1918. 10 x 6½ inches.

The province of British Columbia comprises about 355,000 square miles of territory and contains some of the most magnificent coniferous forests in the world. Owing to differences in topography and climate, however, the vegetation varies greatly—from almost luxuriant forest in the southern coastal region to semi-arid cactus and sagebrush growth on the interior plateaus—and there are approximately 200,000 square miles of country which are incapable of producing forests of commercial value.

British Columbia has been described as a "sea of mountains," and it has been estimated that the average elevation of the land surface for the province is over 3,500 feet. Considered from a physiographic standpoint three great montane regions or "belts," roughly paralleling the seacoast, are to be distinguished: the Western, Central, and Eastern Belts. Each of these belts is further subdivided into two or more mountain or plateau systems, and these, in turn, into specific ranges, groups, or plateaus. The Western Belt comprises (*a*) the Insular System, embracing the mountains on the islands adjoining the mainland; and (*b*) the Pacific System, embracing the Cascade Mountains (a small area lying east of the Fraser River) and the Coast Mountains (including the Bulkley Mountains), together with certain unnamed mountains, on the mainland. The Central Belt comprises (*a*) the Interior System, embracing the Fraser and Nechako plateaus and certain unnamed mountains and plateaus; (*b*) the Cassiar System, embracing the Stikine and Babine Mountains and certain unnamed mountains; and (*c*) the southern portion of the Yukon System, embracing the Yukon Mountains and various unnamed mountains and plateaus. The Eastern Belt comprises (*a*) the Rockies System, here being composed of the Rocky Mountains, and (*b*) the Columbia System, embracing the Selkirk, Monashee, and Cariboo Mountains. In addition to these various montane regions and systems, there are distinguished four great intermontane valleys or trenches: (*a*) the Coastal Trench, lying between the Insular System and the Pacific System; (*b*) the Selkirk Trench, separating the Monashee from the Selkirk Mountains; (*c*) the Purcell Trench, cutting lengthwise through the Selkirk Mountains; and (*d*) the Rocky Mountain Trench, separating the Eastern Belt from the Central. These various physiographic features, discussed in some detail, are clearly brought out on an accompanying map (for the southern portion of the province compare R. A. Daly's map accompanying

"The Nomenclature of the North American Cordillera between the 47th and 53rd Parallels of Latitude," *Geogr. Journ.*, Vol. 27, 1906, p. 588).

Correlated in a general way with the orographic features of the country, and even more important in their relation to the character and distribution of its forests, are a series of climatic belts: (*a*) the Coastal Belt, comprising the coastal islands and mainland and the western slopes of the Coast Mountains; (*b*) the Dry Belt, embracing the eastern slopes of the Coast Mountains and most of the region elsewhere designated as the Central (physiographic) Belt; (*c*) the Interior Wet Belt, centering in the region occupied by the Monashee and Cariboo Mountains; (*d*) the Rocky Mountain Belt, embracing primarily the western slopes of the Rockies; and (*e*) the Great Plains Belt, east of the Rockies. The Coastal Belt is characterized by high precipitation and by comparatively mild temperatures throughout the year; elsewhere, except in the interior wet belt where the precipitation in general is moderate, the climate is relatively dry with pronounced seasonal fluctuations in temperature. Owing mainly to differences in latitude and altitude, however, there are considerable variations in precipitation and temperature within these climatic belts.

The forests of the province are grouped into two divisions: Coastal and Interior. In the Coastal region, five different climatic types are distinguished, in the Interior about fifteen. The nature and composition of each type is briefly discussed, together with its climatic and soil relations, areal distribution, and various economic considerations. Numerous colored maps graphically depict the geographic distribution, not only of these various forest types, but also of the more important forest trees, to which a separate chapter is devoted.

George E. Nichols

Roman Roads in Britain

Thomas Codrington. **Roman Roads in Britain.** 3rd edit. ix and 317 pp.; maps, index. Society for Promoting Christian Knowledge, London, 1918. 10 s. 8 x 5½ inches.

This book is a monument of devotion to detail, assiduity in investigation, and a firm grasp on all phases of the subject, making it a nearly exhaustive disclosure. Every authentic source of information has been drawn upon—Latin works contemporary with the Roman occupation, medieval authors, a copious array of the topographical or incidentally descriptive works of the more recent centuries, the multitudinous widely scattered reports of local investigation, and the testimony of the soil and surface at the present day—often, apparently, as interrogated by Mr. Codrington in person.

Its importance to history and political geography need not be enlarged upon. Perhaps the Saxons preferred the open country after they had settled down, using the Roman roads chiefly to mark boundaries, but the course of invasion must have been largely affected by these easy avenues of ingress, and the sites of battlefields must have been determined in some instances by their river crossings or the points where they penetrated or skirted rough defensible country. But even during the preceding three and a half centuries of imperial rule, at last merely nominal, the movements of the legionaries as well as every shifting of the native population and its commerce, with much beside, must have recorded itself in the opening of new roads, the extension or partial disuse of old ones, and their modifications in various ways.

Where so much has been given, it seems rapacious to call for more; but a series of maps showing these roads as they existed at stated intervals, say at the ends of the first, second, third, and fourth centuries, would be very welcome for purposes of comparison. The concluding chapter partly supplies this need, however, by its speculations as to the dates and order of road-making for the various highways, and the general map appended displays the entire system as now indicated without reference to time of origin or disuse. Perhaps no more could be done; and certainly it is a great deal.

The coins found far in the outskirts of the island indicate that the more important roads were put through early in the period of occupation. Some of them certainly lasted until long after it, as available means of communication and travel. The Laws of Edward the Confessor recite four of these great roads, Ermine Street, Watling Street, Icknield Street, and Fosse Way, as especially under the king's peace, and relate that two of them ran lengthwise of the kingdom, two across. Three of these were recognized in the reign of William the Conqueror. Ermine was the great northern road which ran from London to Lincoln and thence on to North Britain; Watling Street ran northwestward from Dover

and neighboring ports through London and the heart of the country to Wroxeter (Uriconium) and North Wales; Icknield Street ran southwest from the country of the Iceni eastward of Cambridge to Devon, connecting with Fosse Way not very far from Exeter. Fosse Way held a general course east of north from Exeter through Bath and Leicester to Lincoln. Watling Street crosses two of these other main roads; Fosse Way crosses two and joins two. Another great and ancient way was Riknild Street, which ran nearly north and south, branching from Fosse Way opposite Gloucester and approaching Ermine Street near Leeds at the great bend of the latter road to avoid the marsh country on the east. The list of important roads might easily be extended. With their branches, the general effect is to turn the map of Britain into the likeness of a dislocated checkerboard. But apparently through all changes some areas of unconquerable wilderness remained. The greatest of these was south of London, mainly occupied by the Andred wood and crossed only at one or two points in the whole stretch between Canterbury and Winchester. The western part of the Damnonian peninsula and a large expanse in Wales are also blank of Roman roads. But the greater part of the island was exceedingly well supplied with them, and their construction, though variable in different regions and at different times, was generally durable and workmanlike, employing materials which later occupants of the land found an advantage in stripping off freely for their own use.

W. H. Babcock

The Blue Guides Versus Baedeker

Findlay Muirhead, edit. **England.** lxxii and 598 pp.; maps, diagrs., index. (Series: The Blue Guides.) Macmillan & Co., Ltd., London; Librairie Hachette & Cie, Paris, 1920. $5.50. 7 x 4½ inches.

Karl Baedeker. **Great Britain.** Written by J. F. Muirhead. 7th edit., revised and augmented. lxviii and 624 pp.; maps, diagrs., index. Karl Baedeker, Leipzig; T. Fisher Unwin, London; Charles Scribner's Sons, New York, 1910. $3.00. 6½ x 4½ inches.

Here is a peculiar situation—a man with a decided penchant for making a good guidebook has for many years taken a very active part in the preparation of the English editions of Baedeker's Handbooks and wrote the one on Great Britain. In time the great World War develops, and Karl Baedeker is found to hold a very large brief for the Imperial General Staff (see "Baedeker as an Officer of Military Intelligence," *Scientific American*, November 2, 1918, p. 354), while innocently taking in marks, francs, shillings, and dollars for the alluring red-bound books with their comb-marbled edges and the little prayer, "Go, little book, God send thee good passage," etc., on the reverse of title page. What a position for an author! How could he see his life work rendered impossible for English-speaking visitors, for it will be many years before Baedeker's guides will come into the vogue they enjoyed before 1914, if they ever do.

It is interesting to compare the two guidebooks and see whether the recently produced work is an improvement. In the main the verdict is favorable.

The "Practical Information" is excellent, as might be expected from Mr. Muirhead's experience. The constantly changing post-war conditions render this section particularly valuable, and it is severely up-to-date, for we find a chapter on "Aviation in England" and routes and rates for the air services to the Continent.

An "Introduction to the Study of English Monuments," by Professor G. Baldwin Brown (p. xiii), replaces the "Historical Sketch of Architecture in England," by the late Professor Edward A. Freeman in the Baedeker.

The Routes are excellent and are along the same general line as in the Baedeker, for there is really no other way out. The Blue Guide, however, does not embrace Wales or North Britain, which we used to call Scotland. This is of course a limitation which will be sorely felt by the tourist who has but a few days for North Wales or the Trossachs. The book is big enough already, but it is to be hoped the remainder of Great Britain will be provided for by a supplementary volume of small bulk and issued at a low cost.

It must be admitted that the German cartographers have made maps which in some cases are superior to those of the Edinburgh print of the Blue Guides. The plan of Hereford is certainly clearer in the Blue Guide; but the territory embraced in the plan is hardly wide enough for the use of the tourist. The plan of Oxford again makes the mistake of magnifying

the center of the town while several important buildings and other objects of interest are omitted. The maps of the Wye Valley are, with the exception of coloring, almost identical. The reviewer tabulated 55 maps and plans in the two books and after weighing all the points decided in favor of the Blue Guide in 31 cases and Baedeker in 25 cases. There are 12 plans in Baedeker that are not contained in the Blue Guide: Rochester, Hastings, Torquay, Northampton, Coventry, Leicester, Derby, Carlisle, Leeds, Bradford, Newcastle, and Scarborough.

The verdict is, if you can have both books in your library, do so; but, if you can have but one, take the Blue Guide. This will probably permanently displace Baedeker as regards England. As for London, there is also an excellent guide to that city in the new series.

A. A. Hopkins

Historical Geography of the Italian Frontiers About the Adriatic

Attilio Tamaro. **La Vénétie Julienne et la Dalmatie: Histoire de la nation italienne sur ses frontières orientales.** Vol. 1, **La Vénétie Julienne,** xii and 1033 pp.; map, bibliogr.; Vol. 2, **La Dalmatie (depuis les origines jusqu'à la Renaissance),** xi and 501 pp.; map; Vol. 3, **La Dalmatie (depuis la Renaissance jusqu'à la guerre européenne),** xii and 688 pp.; bibliogr. La Società Nazionale "Dante Alighieri," Rome, 1918, 1919. 10 x 6½ inches.

This is the most comprehensive synthetic treatment of the subject known to the reviewer. It is the product of extensive and prolonged study, but it was written in great haste under adverse conditions. The value of the contents is consequently variable. Some topics are given greater space than their importance in relation to the subject seems to warrant, while others are dismissed summarily. A chapter here is based upon important sources difficult of access, while a chapter there contains significant statements supported only by secondary authorities, when the original sources were available. The style is prolix. These inequalities detract somewhat from the value of the large mass of material supplied by the diligence of the author's research. A more serious defect is the writer's prejudice, which has affected both his selection of evidence and his interpretation of it. Tamaro practically acknowledges that the work is in part an attempt to justify the Italian claims to territory on the northern and eastern shores of the Adriatic (Vol. 3, pp. 687, 688). This impresses the reviewer as the principal object of the book. Yet it is not to be dismissed merely as a gigantic piece of propaganda, for it adds much to our knowledge. To the reader who is unfamiliar with the subject it offers a poor avenue for the first approach, but the reader who has a sufficient acquaintance with the subject, or with the principles of historical criticism, can separate the wheat from the chaff, for Tamaro cites his authorities scrupulously.

Geography occupies a considerable place in this primarily historical work. Several chapters are given to descriptive geography, and the historical narrative is often woven about questions of boundaries.

Julian Venetia is a name used by Italians to designate a district north and east of the head of the Adriatic. As no political division appears ever to have borne the title, each writer is left free to assign to Julian Venetia such limits as he sees fit. Tamaro defines it as "bounded by the Alps up to the Fiumara east of Fiume" (Vol. 1, p. 1). This definition is vague. Tamaro therefore proceeds to a more detailed consideration, after giving a brief description of the principal geographical characteristics of the region. He assumes that the boundary of Julian Venetia coincides with the "sacred frontiers" which Nature gave to Italy on the northeast. These are established by the summits of the mountains which divide the waters flowing into the Black Sea from those flowing into the Adriatic. Tamaro's attempt to locate the line of crests, however, leaves one with the impression that Nature did her work in a slovenly fashion. From the Predil pass to the headwaters of the Idria the course of the watershed is clear enough, but south of Idria the Piuca and the Uncia Rivers follow the custom of the Carso and disappear in the earth. Some geographers maintain that the Piuca runs into the Uncia and the Uncia into the Save, but Tamaro holds that this view has not been sufficiently well proved by scientific experiments to exclude the possibility that these rivers drain into the Adriatic. Tamaro discusses the views of several German and Italian geographers, making evident the inability of Italian scientists to agree among themselves as to the course of the sacred frontier in this region. He finally accepts the hypothesis of Porena that the boundary goes southward from the headwaters of the

Idria to Mt. Nevoso (Schneeberg) by way of the Birnbaumer Wald (Selva del Pero) and Mts. Strana, Javornig, and Toro, dividing the basin of the Piuca from that of the Uncia. Thence he draws the line down the mountains to the source of the Fiumara and along the left bank of that stream to the sea. Irredentists of the sixties, like Bonfiglio, who recognized the Arsa as the proper frontier are dismissed as ignorant political opportunists.

The history of the northeastern boundary is scattered here and there throughout the remainder of the first volume. Tamaro's thesis seems to be that the boundary of Italy since Roman times has generally extended as far to the east, either in fact or in national consciousness, as he places it. He has accumulated a vast store of evidence, but his interpretation of it is not always to be trusted. In a summary of the views of those authorities who hold that the Julian Alps constitute the natural frontier of Italy he speaks of "the historian of the invasions of Italy, Hodgkins (*sic*), who has marked the frontier passed and violated by them at the great Alpine wall which encloses Julian Venetia" (p. 33). The only reference to the Alpine wall at the place indicated in Hodgkin's work is a note which reads: "Is the fury of the Bora owing to the abrupt termination here [*i. e.* Tarnovaner Wald] of the great Alpine Wall . . .?" Hodgkin gives no indication that he regards the Alpine wall as the boundary of Italy or of Julian Venetia. The conclusions that Tamaro draws from his evidence, moreover, appear in some instances to be unjustified. He, for example, places Laibach within Italy in the fourth century (p. 95). The anonymous author of Bordeaux, whom he cites, corroborates this statement; but Herodien, whom he also cites, says nothing about Laibach at the place specified. From this evidence, furthermore, it does not necessarily follow, as Tamaro asserts, that the political frontier of Italy had been extended beyond the Arsa, where it was located in the first century. His supposition that Fiume (Tarsatica) was then part of Italy is, as he admits, based upon no direct evidence. Concerning Dante's famous lines,

> ". . . Pola presso del Quarnaro
> Che Italia chiude e i suoi termini bagna,"

he tells us (p. 359): "The designation of Dante cannot be taken in a narrow sense, as if the poet intended to limit the Italian frontier to the Arsa. He meant, on the contrary, to include in it all the eastern coast of Istria up to the head of the gulf of Quarnero." But he does not explain how he knows what Dante meant. In another instance he draws a conclusion that does not seem to be warranted by his own interpretation of the evidence. He says (p. 354) of Riccobaldo of Ferrara, who wrote a geographical description between 1280 and 1300: "It is interesting to note that he places the frontier of Istria in the Liburnian gulf, therefore beyond the Arsa and manifestly in the angle where the Fiumara, the ancient Tarsia, disembogues." It seems far from manifest that the general statement of Riccobaldo refers specifically to the one spot in the Quarnero selected by Tamaro. Instances of these sorts are sufficiently frequent to make it advisable to refer to the authorities whom Tamaro cites before accepting unreservedly his statements with regard to the history of the northeastern boundary. His work on this aspect of the subject, nevertheless, is not without value, because he has brought together references to a vastly larger number of sources than are to be found in any other single work.

The volumes on Dalmatia begin with five chapters of descriptive geography where the view is advanced that Dalmatia does not belong to the Balkan Peninsula but forms part of Italy geologically, orographically, biologically, and anthropogeographically. In subsequent chapters there is little of geographical interest. The opinions of contemporaries who at various epochs looked upon Dalmatia as geographically a part of Italy are adduced occasionally, and the history of the Dalmatian boundaries also receives some notice but is treated as a topic of slight importance.

W. E. Lunt

Primitive Peoples of Cochin-China

Henry Baudesson. **Indo-China and Its Primitive People.** Transl. by E. A. Holt. xii and 328 pp.; ills., bibliogr. E. P. Dutton & Co., New York, [1919]. $5.00. 8½ x 5½ inches.

A scholarly treatment of the Moï and the Cham, two distinct peoples living in the mountains of Cochin China a hundred miles or so west of the China Sea. Their country is, politically, a French protectorate. While primitive peoples, they have made some advance-

ment, and Captain Baudesson calls them "half civilized." The Moï have a legend that Mother Eve told those of her sons who were jolly fellows and fond of good living to settle on the fertile plains; but to one of her sons, a quiet and sober lad, she gave a bow and arrows and the kingdom of the mountains where the wild beasts roam. He was the ancestor of the Moï, who, the author says, may number nearly 400,000.

The Cham, on the other hand, supposed to number about 130,000 souls, have approached a little nearer to what we call civilization. They are Mohammedans and have preserved their physical and moral characteristics largely because they do not intermarry with other peoples. But retrogression is in progress. They are indolent, have no ambition, hire the Annamites to build their rude houses, and, at the same time, are proud of the ruins of splendid edifices erected long ago by their forefathers. The author also points to striking resemblances between customs and superstitions among the blacks of central Africa and the lower classes among these Asian peoples.

Cyrus C. Adams

Morphology of the Altai Mountains

J. G. Granö. **Les formes du relief dans l'Altaï russe et leur genèse: étude morphologique.** Maps, ills., bibliogr. *Fennia*, Vol. 40, No. 2, pp. 1-125. Helsingfors, 1917-19.

No more striking example of the explanatory treatment of mountain forms has appeared in recent years than the above article by the Finnish geographer, Granö, of the University of Helsingfors. The northwestern or Russian part of the Altai Mountains between the upper courses of the Obi and Irtysh Rivers—an area measuring 400 kilometers northeastward by 350 northwestward—is described as consisting of an uplifted and dislocated peneplain in a more or less advanced stage of erosion, the peneplain having been produced over a vast area by long-continued normal erosion of greatly deformed structures, and its undisturbed extension being still seen in the piedmont steppes to the northwest. The least dissected part of the uplifted peneplain forms a series of barren, tundra-like highlands, which occupy the greater part of the southeastern half of the region at altitudes of from 2,000 to 2,300 meters. The small amount of dissection that the highland peneplain has suffered, apart from the deep valleys which traverse it, is because its altitude is such that during the glacial period it was covered for the most part by a sluggish ice sheet and thus protected from active erosion. The highlands are surmounted by mountains of various kinds. Some are of subdued forms, apparently residual ranges still surviving from the cycle of peneplanation (these presumably follow the trend of resistant structures); the smaller isolated residuals are dulled monadnocks. But there are also lofty ranges of Alpine form, from 50 to 100 kilometers or more in length and from 2,400 to 4,000 meters in altitude, with extensive snow fields on their upper slopes and good-sized glaciers in their valleys; these ranges usually trend east and west, out of accord with the folded structure of the region, and are regarded as blocks of the peneplain which were dislocated by faulting and raised so high that they have been strongly carved by normal and glacial erosion. Some of the less elevated ranges still exhibit remnants of the peneplain surface along their crests; others have all their sharpened summits at about the same level; but in the most lofty ranges no trace of the peneplain remains. The frontier between Russian and Chinese territory follows several of the lofty ranges which here constitute the divide between Arctic and interior river systems.

Almost half of the region lies exterior to the barren highlands at altitudes decreasing northwestward from 2,000 to 500 meters; here, although the uplifted peneplain is preserved along certain divides, it is for the most part maturely dissected by normal erosion to mountainous or submountainous forms, which are richly grass-covered on certain southern slopes, but generally forested. The piedmont peneplain has a width of from 40 to 70 kilometers; its gently undulating, treeless surface, here and there rising in low and somewhat craggy mounts, is almost intact at altitudes of 300 or 400 meters, but the larger rivers have recently incised their courses moderately beneath its surface. Farther northwest the vast Siberian plains are covered with sand and clay deposits.

The valleys of the Altai in the forested mountainous or sub-mountainous area are usually V-shaped and so narrow-floored that they do not serve well as paths of travel. But the upper valleys of the larger rivers and their chief branches which head in the Alpine region and continue through the highlands appear to have been followed by active glaciers,

as they now have the form of glacially overdeepened troughs. The greater troughs extend into the maturely dissected area, where they terminate at altitudes of about 400 meters. The earlier view of certain observers that the trough valleys are due to faulting is examined and rejected. Their open floors are more available for travel than the narrow bottoms of the V-shaped valleys, and they serve here and there as sites for the winter villages of the nomadic natives, when the highlands are snow-covered. Certain branch valleys are broadly floored with alluvial deposits, as if they had held temporary lakes while their trunk valleys were occupied by glaciers. On the other hand, several rather extensive intermont basins, occupied by smoothly aggraded alluvial plains, are ascribed to down-faulting and thus are the opposites of the strongly elevated blocks in the lofty ranges.

This valuable article, of which the preceding paragraphs give only a condensed abstract, calls for several comments. It is in the first place pre-eminently intelligible. The landscapes that it describes in outline can be at once visualized with satisfactory definiteness as to their essential qualities. The general concepts thus gained are then elaborated and given quantitative values in order to adapt them to specific instances. This intelligibility, to which the explanatory terminology so largely contributes, is however somewhat obscured by an argumentative manner of presentation on many pages. This manner appears to have been adopted because of the author's well-grounded wish to modify, if not to combat, the conclusions of a number of earlier explorers, some of whom seem to have been little informed as to modern physiographic principles. Such argumentative presentation is a natural characteristic of the developmental stage of an advancing science, when opinions are in a formative state. A more concise form of explanatory presentation will be generally utilized when the majority of explorers reach essential agreement as to the manner of describing land forms; indeed, such conciseness is already adopted by Granö in certain summaries near the close of his article. Had these summaries been placed at the beginning, his readers might have had the enjoyment of following the author's descriptions and discussions while bearing his well-formed conclusions in mind; for, however cautiously and inductively an observer may wish to establish his conclusions, mature and expert readers will be best satisfied if they are told the main conclusions before they read the evidence that leads to them. Geometers have long known and acted on this principle; geographers might profitably adopt it.

A subordinate difficulty in reading the text is the free use of local names, which, although most of them are represented on an outline map, are mentioned without sufficient indication of their position in the region under discussion. Where the matter is so excellent, one must wish that the method should be of a correspondingly high order.

It is only in regard to forms of a special class that the treatment is defective, these are the fault scarps by which the lofty ranges are believed to be limited. In a region that has been recently and rapidly elevated and dislocated, and in which the highest ranges are defined by faults, fault scarps, even though for the most part destroyed by erosion, might still be visible in series of spur-end facets which should stand in simple alignment independent of structure along the base of the ranges. True, one range according to the description of another observer, is said to "rise like a wall"; but mountain-side walls are so battered and breached that fuller description is desirable; and in the case of fault-block ranges observed by Granö himself fuller description might have been advantageously given. This is a small deficiency of an exceptionally valuable essay.

W. M. Davis

A Seaman in the Antarctic

J. K. Davis. **With the "Aurora" in the Antarctic, 1911-1914.** xxii and 183 pp.; maps, diagrs., ills., index. Andrew Melrose, London, [1920]. 18 s. 9½ x 7 inches.

Three different methods of exploration have been employed to wrest her secrets from the icebound southern continent. Two of these, dealing with the polar plateau and with land journeys along the coast, have been described in many well-known books. It has remained for Captain John King Davis to tell us of the third in his recent book "With the *Aurora* in the Antarctic."

Here we find the story of his unrivaled oceanographic work in the waters between Australia and Antarctica during the Australasian expedition of 1911–1914. Although in other expeditions valuable results were gained by the exploring vessels during their cruises in

the winter months, none of these equals the work done by the *Aurora*, and none of the masters has hitherto given us more than a summary of his investigations.

An early chapter deals with Macquarie Island, that queer ridge of glaciated rock which may be described as a tile set on edge athwart the wild west winds. All round this dependency of the Commonwealth the *Aurora* made soundings which revealed the profundity of the depths surrounding it. Then we are told of the mysterious Royal Company Isles which were "discovered" in 1776 by a Spanish captain about 400 miles south of Tasmania. Unfortunately for the Spaniard, Davis sailed right across the alleged position of these islands, which must now disappear from the charts. Another interesting chapter deals with the Auckland Isles to the south of New Zealand. We should have liked more particulars of the castaways and settlements which have enlivened the history of these desolate subantarctic islands.

In November, 1912, Davis was dredging 250 miles south of Tasmania when his apparatus was carried away by what may best be described as a crag of a "drowned Tasmania." Rising 8,000 feet above the ocean floor he found a large plateau, "Mill Rise," which raises interesting questions as to a former connection between Australia and Antarctica.

The most vital chapters in the book deal with his hazardous voyages along the icebound coast of Antarctica. The reviewer has spent many months sledging in the Antarctic and has had some slight experience of aviation, but for supreme danger and discomfort he places easily first a cruise among the bergs in the twilight of a polar autumn. Yet this was a commonplace to Captain Davis—the most experienced navigator of Antarctic waters. We read much of the treachery of the famous blizzards. For instance, while waiting to take off Mawson's party at the main base, the *Aurora* was anchored a short distance from the shore. The boats had just taken advantage of a period of calm to land some stores. Suddenly a single terrific gust struck the ship, snapped the anchor chain, and blew the *Aurora* far to the north.

A typical account of the weather describes the day when Mawson was successfully picked up. "At 8 A. M. the land became invisible owing to the driving spray and drift. At 10 A. M. the wind averaged about 70 miles an hour, with squalls of terrific violence. At 11 it reached the strength of a hurricane, the sea was cut off almost flat by the force of the wind. The glass has fallen three-tenths of an inch." We are not surprised that the *Aurora* broke two anchors and lost three others in these tempestuous seas.

Later chapters describe the variations in the ice pack off Antarctica. It is most interesting to know that 1914 was marked by an unusually wide and unbroken belt of pack ice. Is it not possible that this greatly affected the temperature of Australian waters and was a vital factor in determining the great drought of that year? In this section the book is specially well illustrated with sketch maps.

Davis is generous in his praise of the French and American expeditions of 1840. There is a full appreciation of the heroic struggles of Lieutenant Wilkes, Davis following stage by stage the gallant voyages of the sailing ship *Vincennes* in these perilous seas. A series of comparative charts show that the old sailing vessel has rarely been beaten even in these days of steam. We learn that Côte Clairie of the French turns out to have been merely Ice Barrier, for the *Aurora* sailed nearly 100 miles south of this. Here she discovered a new land to which the Australians gave the name of Wilkes Land.

In the last chapter Davis sounds a note of warning: "To the explorer who has not the money to provide good equipment of every kind, my advice is—keep out of the Antarctic!"

GRIFFITH TAYLOR

A TEXTBOOK OF METEOROLOGICAL PHYSICS

W. J. HUMPHREYS. **Physics of the Air.** xi and 665 pp.; maps, diagrs., ills., index. The Franklin Inst. of the State of Pennsylvania. J. B. Lippincott Co., Philadelphia, 1920. $5.00. 9½ x 6½ inches.

The foremost aerographer of Europe in the preface to his "Manual of Meteorology" (1919) said,

"The physical and dynamical principles upon which the processes of weather depend are the common property of all students of physics. If those to whose care the progress of physics is entrusted had taken the physical problems of the atmosphere under their charge as their predecessors did before the advent of the electrical era, one-half at least of this book might have been more effectively dealt with by other hands."

"Physics of the Air" may well be regarded as an answer to this indictment of physicists for neglect. In part it meets the demand of aerologists for a special, up-to-date treatise. But here a strange condition of affairs confronts one. For physics today is not the established, slowly changing physics of a few years back; but a more complex and rapidly changing study of the structure of the atom, modifying views heretofore held as fundamental in astronomy, biology, chemistry, geology, and mechanics.

In fact the favorite occupation of physicists now seems to be "giving a jolt" to classical dynamics. One may not reasonably then expect a book on physics to be strictly up-to-date; unless the volume comes hot from the press. Where publication is delayed a technical treatise is sure to suffer. In the present book one looks in vain for recent determinations of Planck's constant, the value of the electron charge, molecular weights, and atomic numbers.

Professor Humphreys states that the book is an attempt to present "an orderly assemblage of facts and theories connected with the physics of the earth's atmosphere." Mechanics might well be added. The volume originated in a series of lectures delivered at an aviation school in 1914; and these have been expanded, revised, and from month to month printed in the *Journal of the Franklin Institute*, 1917–1920. Many of the diagrams and much of the text are reproduced with slight changes from articles by the author and others in Weather Bureau publications.

There are four parts: I, Mechanics and Thermodynamics; II, Electricity and Auroras; III, Optics; and IV, Factors of Climatic Control.

The book is rather weighty; too large, we think, for convenient handling; but this is doubtless because of the extent of the field covered. Would it not have been better, to have excluded, as far as possible, the chapters on Vulcanism, which are geophysics rather than aerophysics? Part IV, as the author says, "is a discussion of the physics of climate but not of its geographic distribution" which is Hamlet with Hamlet omitted. The subject is one of such importance and of so much interest to others beside meteorologists that we venture to express a hope that Professor Humphreys will amplify this portion of the book in a separate volume, to be called perhaps "Evolution of Climate."

Part II, entitled "Atmospheric Electricity and Auroras," consists of two chapters, nineteen pages. Would it not have been more appropriate to include under Part II, Chapters XV and XVI on Thunderstorms and Lightning now in Part I? More especially so, because Part I is disproportionately long, consisting of sixteen chapters, four hundred twenty-five pages, a book in itself.

Part III deals exhaustively with optical effects, and is drawn chiefly from Pernter and Exner's "Meteorologische Optik," supplemented by some of the papers of the former Lord Rayleigh published in the *Philosophical Magazine*. Here the work of a distinguished American (Barus) on Nucleation has apparently been overlooked. Refraction phenomena are dealt with at great length. There is an interesting explanation of the "green flash" as a refraction effect.

On page 448 is an amusing paragraph with the fine flavor of a problem in relativity: "It is conceivable therefore, that the size of a planet and the vertical density gradient of its atmosphere might be such that one's horizon on it would include the entire surface—that he could look all the way round and, as some one has said, see his own back." Some doubting Thomas will at once ask, "What kind of a temperature distribution could produce such a density lapse rate?"

Looming, towering, sinking, and stooping; also superior and lateral mirage are terms used and defined; and we suspect that some of these are freshly coined. There is, however, no specific definition of visibility, nor its complement obscuration; or tables such as are now used at aviation centers.

The volume being quasi official, a wider range of criticism may be permitted than ordinarily would apply; and so we feel forced to point out that Chapter I, headed "Observations," is of a prewar order, not up to the requirements of the present time and certainly not up to the high level of the rest of the book. There are time-worn illustrations of a Robinson anemometer and a sling psychrometer but only the barest mention of Dines' pressure-tube anemometer and the modern humidity instruments. To be sure, elsewhere in the book a pressure-tube anemogram is given to illustrate gustiness; but, even then the record is an old one [Aberdeen, January 6, 1908], in fact one of the earliest, one in which the wind direction is not automatic but is added by hand. So many excellent anemobiograph records are available that the selection must be regarded as inadequate.

It may also be noted that the reference given on page 221 to this pressure-tube trace is

erroneous; as Figure 31 is an assumed temperature gradient. A minor error occurs on the same page regarding billows in the low atmosphere and pressure changes of 0.1 mm. to 0.3 mm. Figure 57 is an old-fashioned scale in inches, not millimeters as the text requires. Again, the elevation of the station is omitted; and so we have the incongruity of a pressure curve representing an anticyclone in which the pressure reading is 29.05 inches. On page 227 the scales are again confused.

In the discussion of tropical cyclones, no mention is made of the work of Algué, Froc, or Fassig; and one looks in vain in the index for "*baguio*," "hurricane," and "typhoon"; and yet "bumps" is duly given. The work of Bigelow, Barus, both Bjerknes, Cave, Dines (J. S.), Dobson, Eiffel, Margules, Rotch, and many others is not mentioned. Certainly Bjerknes's graphic methods of dynamical meteorology and Bigelow's explanation of the origin of cyclones, whether accepted or not, should have been referred to; as well as the various papers of the latter on circulation and radiation in the atmosphere.

Some confusion exists in the use of units and symbols. *R* for example, is employed as symbol for gas constant, ohmic resistence, radius of rain-drop, radius of the earth, rain, and resultant amplitude. In general Professor Humphreys keeps closely to the Centigrade scale and C. G. S. units. In formulae for gradient winds, pressure differences are expressed in dynes per square centimeter which is now becoming general in aerographic literature. But, notwithstanding this, the meteorological bar is used and not the bar of the physicist.

Alexander McAdie

The Prediction of Minimum Temperatures

J. Warren Smith, and Others. **Predicting Minimum Temperatures from Hygrometric Data.** 76 pp.: maps, diagrs., ills., bibliogr. *Monthly Weather Rev. Suppl. No. 16.* U. S. Dept. of Agriculture, Washington, D. C., 1920.

The need for predicting minimum temperatures is imperative in fruit regions where the growers must protect their crops against freezing. But fruit growers cannot afford the expense of protection every time the temperature *may* fall dangerously low; so an accuracy of prediction within two or three degrees (F.) is practically required when temperatures in the twenties are expected. Since most methods of protection are useless on windy nights, profitable fruit growing is confined to regions where at critical seasons the temperatures do not fall much below freezing except on clear, quiet nights. The forecaster's problem, then, is to pick, from weather map indications and the local aspect of the sky, the nights which will probably be clear and then to compute how low the temperature will fall. Under clear skies the rate of cooling is closely dependent on the moisture content of the air—dry air favoring strong radiation and a large fall in temperature. Thus, observations of humidity in the afternoon or evening can be used to predict accurately the next morning's minimum temperature when a clear night with but little wind is expected.

This collection of papers, prepared under Professor Smith's guidance, shows in detail how hygrometric data are used in actual practice in different fruit regions. Graphical and statistical methods brought into action insure the employment of the best means and the greatest accuracy at present attainable. The observations of a central station in a fruit region can be used for predicting minimum temperatures at places even several miles away, once the usual temperature differences between the central station and the outlying locality are known. Thus, if the central station has some years' length of record, only a few months' observations in different orchards are necessary before accurate local temperature forecasts are possible.

Aside from the discussions centered about the use of hygrometric data, two contributions deserve special mention. On pages 20–30 Dr. H. J. Franklin has presented a detailed discussion of "Cape Cod Cranberry Frosts," how forecast, the temperature resistance of cranberries in different stages, and ways to protect bogs from frost. On pages 46–49 Mr. J. Cecil Alter discusses "Forecasting Minimum Temperatures in Utah" especially "for sheep shearing and lambing and fruit-raising interests in spring; alfalfa seed, tomato, and vegetable interests in autumn; and shippers of perishable products and users of stream flow for hydroelectric purposes in winter." . . .

A specialized bibliography of 12 titles closes the group of papers.

Charles F. Brooks

In Praise of thf Map

W. P. James. **The Lure of the Map.** 2nd edit. vii and 120 pp. Methuen & Co., Ltd., London, 1920. 7 x 4½ inches.

The writer of this delightful little collection of literary essays informs his readers that if he had to choose one work to take with him to a desert island he would take an atlas. Surely the book of a man who thinks in this way deserves to be brought to the attention of geographers.

Six of the seven essays deal with subjects related to geography. The first, from which the collection takes its title, reveals the fascination of maps both ancient and modern. "Local Colour" tells of the search and conquest by novelists of an elusive genius loci. "Odysseys Old and New" analyses with a light hand the appeal that unknown countries have always made to the imagination, and "In Excelsis" carries the reader among mountain crags and snows with the Alpinists of the last two centuries. "Of the Lineage of Yorick" opens up the world of those men whose feeling for the spirit of foreign lands was truest—Borrow, Stevenson, Kinglake, Doughty, and others; while, in conclusion, "Pilgrims, Pirates, and Merchant Adventurers" introduces us to the possibilities of that most vital and absorbing field of historical study, the history of geographical discovery.

Quite apart from the charm of its own style and substance, this book serves as an admirable introduction to those works of travel which have achieved recognition and maintained a high place in English literature.

CORRESPONDENCE

A letter received from Mr. L. C. W. Bonacina of London, England, takes up the discussion of the philosophy of natural beauty thus:

The note by Professor Davis in the *Geographical Review* for December 1920 prompts me to reply to the difficulty which he proffers about the intrinsic nature of landscape beauty, whether objective or subjective reality. Apart from Sir Francis Younghusband's representations in the *Geographical Journal* for July, 1920, which I most ardently uphold, I have myself been up against Professor Davis's question in deciding to what extent the discussion of natural beauty should find place in a work I am planning on the climate of England. To unravel this metaphysical intricacy one must first of all bear in mind that natural phenomena may be studied in regard to (1) their causes, (2) the actual phenomena themselves, (3) their effects. Now physical beauty can, I submit, be defined, for present purposes, as an effect of material dispositions upon the human mind and soul, and, therefore, may properly be discussed in scientific works under (3) above. In a strict sense, of course, all physical phenomena are only known as effects upon the mind which perceives them; but I employ the term "effect" to denote less direct influences such as, for example, that of environment upon the human mind and body. Thus a tree may be "beautiful" because the total disposition of material elements composing it endows the tree with a kind of personality which pleases and inspires the spirit. Consequently, while it is always right to express in a book what we *feel* about the beauty of mountain, tree, cloud, or other elements of landscape, it is only philosophical to discuss what we *know* of the beauty in writings which treat of the effects of physical phenomena as distinct from the things in themselves. This conclusion does not refute the proposition, quoted by Professor Davis, that "beauty is truth, truth beauty," that beauty is, indeed, an eternal verity; but it does demonstrate that high imaginative and intellectual faculties are required to comprehend and interpret the quality of beauty,—as it certainly postulates Omniscient Power behind the evolutionary processes of the universe.

The metaphysical explanation of natural beauty may perhaps be rendered clearer by considering the simpler case of light. Objectively, light consists of electro-magnetic undulations in a medium, but light as light is a subjective reality only in relation to sentient beings. Similarly, the objective foundations of beauty are infinitely varied and complex; but beauty as beauty is subjective, and exists only in relation to self-conscious beings.

L. C. W. Bonacina

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OUR CONTRIBUTORS

Dr. Arctowski is professor of geodesy in the University of Lemberg. He is well known for his investigations on the subject of climatic change both in its astrophysical relations and its practical bearings. His first contribution to the subject was his discovery, while attached to the Belgian Antarctic Expedition, 1897–1899, of the former great extension of glaciation in the Antarctic regions. He has published several papers on secular variation of climate in North America and other regions including "Studies on Climate and Crops" (*Bull. Amer. Geogr. Soc.*, Vol. 42, 1910). For the American Commission to Negotiate Peace Dr. Arctowski prepared a series of elaborate statistical reports on Poland. Data collected then form the basis of the present article.

Mr. Ogilvie has recently joined the staff of the American Geographical Society in which he is responsible for the work of the Hispanic American division. Mr. Ogilvie had previously held positions on the staff of the Oxford School of Geography and as Reader in the University of Manchester, England. During most of his war service with the British Army he was engaged in geographical work—at Gallipoli, Saloniki, and in Paris at the Peace Conference. Mr. Ogilvie's geographical writings include regional papers on Morocco, Imbros and Macedonia, physical studies on glaciers and impressions of vegetation in the United States, observations made during the Transcontinental Excursion of the American Geographical Society in 1912.

Mr. English is an instructor in the department of English of the University of Wisconsin.

General Scriven's military duties have taken him to many parts of the world during the last forty years. In 1894 he was military attaché at Mexico City and for the next three years at Rome. In 1897 he was detailed with the Turkish forces. During the next four years he saw service in Cuba, the Philippines, and China. He has been variously connected with the Signal Corps, in 1909–1911 as chief signal officer of the Philippines Division, in 1914–1917 as Chief Signal Officer of the Army. In the fall of 1917 he was designated as military attaché to the United States Embassy in Rome. In this capacity he visited the Italian front along the Piave River and later accompanied General Ferraro in the campaign in Albania, on which occasion he made the observations embodied in the present article and that entitled "The Awakening of Albania" (*Geogr. Rev.*, August, 1919).

Miss E. M. Sanders is senior lecturer in geography at the Furzedown Training College, London. Miss Sanders was a British Scholar at Bryn Mawr College in 1917. Later she was engaged in geographical work at the War Office in Washington and she has recently assisted Dr. Ellsworth Huntington in research work at Yale University. She has written a geographical study "La Région de Bristol" (Thèse Doctorat Faculté des Sciences Université—Paris, 1914).

The late Mr. Cushing was head of the department of geography at the State Normal School, Salem, Mass. His writings include several papers on the East Coast of India (including one published under this title in the *Bull. Amer. Geogr. Soc.*, Vol. 45, 1913), the result of field studies made in 1910–1911. He is joint author with Dr. Huntington of "Principles of Human Geography" (1921) and "Commercial and Industrial Geography" (in press). As Captain in the Military Intelligence Division of the General Staff, 1918–1919, he prepared and edited military handbooks and monographs on various countries.

Dr. Huntington is research associate in geography at Yale University. Dr. Huntington has especially studied the question of secular changes in climate and their influence on civilization. His explorations have been mainly in Syria, Asia Minor, Persia, and Turkestan. Besides numerous papers he has written "A Geological and Physiographical Reconnaissance in Central Turkestan; The Basin of Eastern Persia and Sistan" (*Carnegie Inst. Publ. 26*); "The Pulse of Asia" (1907); "Palestine and Its Transformation" (1911); "The Climatic Factor as Illustrated in Arid America" (*Carnegie Inst. Publ. 192*); "Civilization and Climate" (1915); "World Power and Evolution" (1919), and, in collaboration with Mr. Cushing, the two books mentioned above.

Mr. Babcock is a lawyer and author, of Washington, D. C., who has devoted himself to the history of early cartography and geography. He has written on the Vinland Problem and has contributed to the *Geographical Review* a series of articles dealing with the mythical islands of the Atlantic on medieval maps.

Mr. Stefansson is known for his repeated journeys in the Arctic and especially for his work as leader of the Canadian Arctic Expedition, 1913–1918. He has contributed several articles to the *Review* and is the author of an admirable book entitled "My Life with the Eskimo," 1913. His field work is characterized by an intimate knowledge of native living conditions and of the technique of Arctic travel.

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AGRICULTURE AND LANDOWNERSHIP IN POLAND

By HENRYK ARCTOWSKI
University of Lemberg

Of the post-war economic problems facing the European nations those of Poland may well be described as unique. In addition to reparation of the ravages of war and to the adjustment of frontier difficulties the reconstituted nation must organize and consolidate lands subjected for more than a century to alien powers. The complexity of the situation is realized in an attempt to estimate that vital question—the future of Polish agriculture.

At present the food requirements of the people can be satisfied only in a very restricted way, and hundreds of thousands of families are starving. During the winter the death rate rose very high, hunger typhus making great ravages among the poor. Import of food commodities has been practically impossible, mainly because of the prohibitive rate of exchange. Last summer the cornfields looked most promising, but the military reverses and the consequent retreat of the Polish army brought the Bolshevist front far into Poland just at harvest time. The entire country north and east of this battle front (see Fig. 1) was completely devastated, and Poland has received no compensation from Bolshevist Russia for this destruction, no payment for the destroyed crops and property.

Thus it is easy to understand that the present conditions are abnormal and that the potential agricultural possibilities of Poland can be judged only by the statistical data of former years.

SOURCE OF THE STATISTICAL DATA

It was my privilege to compile the statistical data concerning Poland for the American Delegation to the Peace Conference. The figures given below are taken from the extensive report on agriculture which I then prepared. The original figures used for that report were taken from official Austrian, Prussian, and Russian publications.

In order to have a satisfactory approximation, averages of the five years 1908–1912 were made. Population statistics of 1910 gave the figures needed for calculating the yield per capita.

The entire area of the territories to the east and north belonging to Poland before the partition of 1772 was taken into consideration, as well as the Mazurian districts of East Prussia, Upper Silesia, and the Teschen district. But, since the present boundaries of Poland do not correspond perfectly to old administrative divisions, an exact calculation cannot be made. For example, the frontier established by the Peace Conference of Paris cuts away in favor of Germany parts of several districts of the province of Posen. Thus inclusion of the entire agricultural production of the province gives a grand total which is too high. This discrepancy, however, may be corrected to a great extent by making the calculation per capita.

On the inserted maps (Fig. 2) the shadings corresponding to the different gradations per capita are given for the entire area for which I compiled statistical data (with the exception of East Prussia), whereas the figures tabulated to accompany the maps are only for those provinces or governments that were incorporated (entirely or in part) into Poland by the Peace Conference of Paris and the provisional agreement with the Soviet Government of Russia at the Riga Conference (Fig. 1).

The population of these areas in 1910 is shown in Table I.

Table I—Population of Polish Provinces

Posen (Poznania)	1,335,884	Congress Poland	12,129,200
Bromberg	763,945	Vilna (Wilno)	1,996,900
Danzig	742,619	Grodno	1,951,700
Marienwerder	960,855	Volhynia	3,846,500
Cracow	2,689,854	Upper Silesia	2,207,981
Lemberg (Lwów)	5,335,821	*Total*	33,961,259

Summary of Production and Consumption

For the total population as given in Table I the production of food crops (not including vegetables and fruit) per annum per capita was: wheat, 61 kilograms; rye, 190; barley, 51; oats, 98; potatoes, 814; beet sugar, 20.

Table II—Grain Requirements in Germany, Russia, and Congress Poland

(*Kilograms per capita*)

	Germany	Russia	Congress Poland
Wheat	89.4	94.3	51
Rye	143.8	127.7	157
Barley	88.8	39.3	39
Oats	123.5	85.2	78

As regards consumption, however, these figures are too high because the quantities necessary for seed have not been subtracted. The average seed requirements may be placed at one-eighth of the crop. Subtracting this fraction from the total production we have: wheat and rye, 220 kilograms; barley, 45; potatoes, 642.

An estimate of the grain requirements of the population has been made by Rasinski[1] on the basis that consumption in Poland is intermediary between

FIG. 1—Key map to accompany the distribution maps of Poland. The boundaries are thus: 1, boundaries established by the Peace Conference of Paris and by subsequent plebiscites; 2, limits of plebiscite areas (in the case of Teschen, Orawa, and Spits the limits of the disputed areas are shown and the proposed boundary according to preliminary agreement between Poland and Czecho-Slovakia); 3, preliminary line of the Riga Conference (Oct., 1920); 4, military demarcation line between Poland and Latvia and Lithuania (1919); 5, international boundaries of 1914; 6, interprovincial and intergovernmental boundaries of 1914.

Germany and Russia. Taking into account the export and import of grain and flour and the net production after deducting 13 per cent for seed, he arrived at the actual requirement for Congress Poland. It is given in Table II along with consumption in Germany and Russia (1907–1911).

As the requirements may be supposed to be slightly higher in Posen and much lower in the eastern provinces, the available average of 250 kilograms of wheat and rye is therefore higher than the normal requirement, leaving a certain quantity of grain (about 407,000 tons) available for storage or export.

[1] F. Rasinski: Sily twórcze, Petrograd, 1916.

THE CHIEF FOOD CROPS OF POLAND IN RELATION TO POPULATION

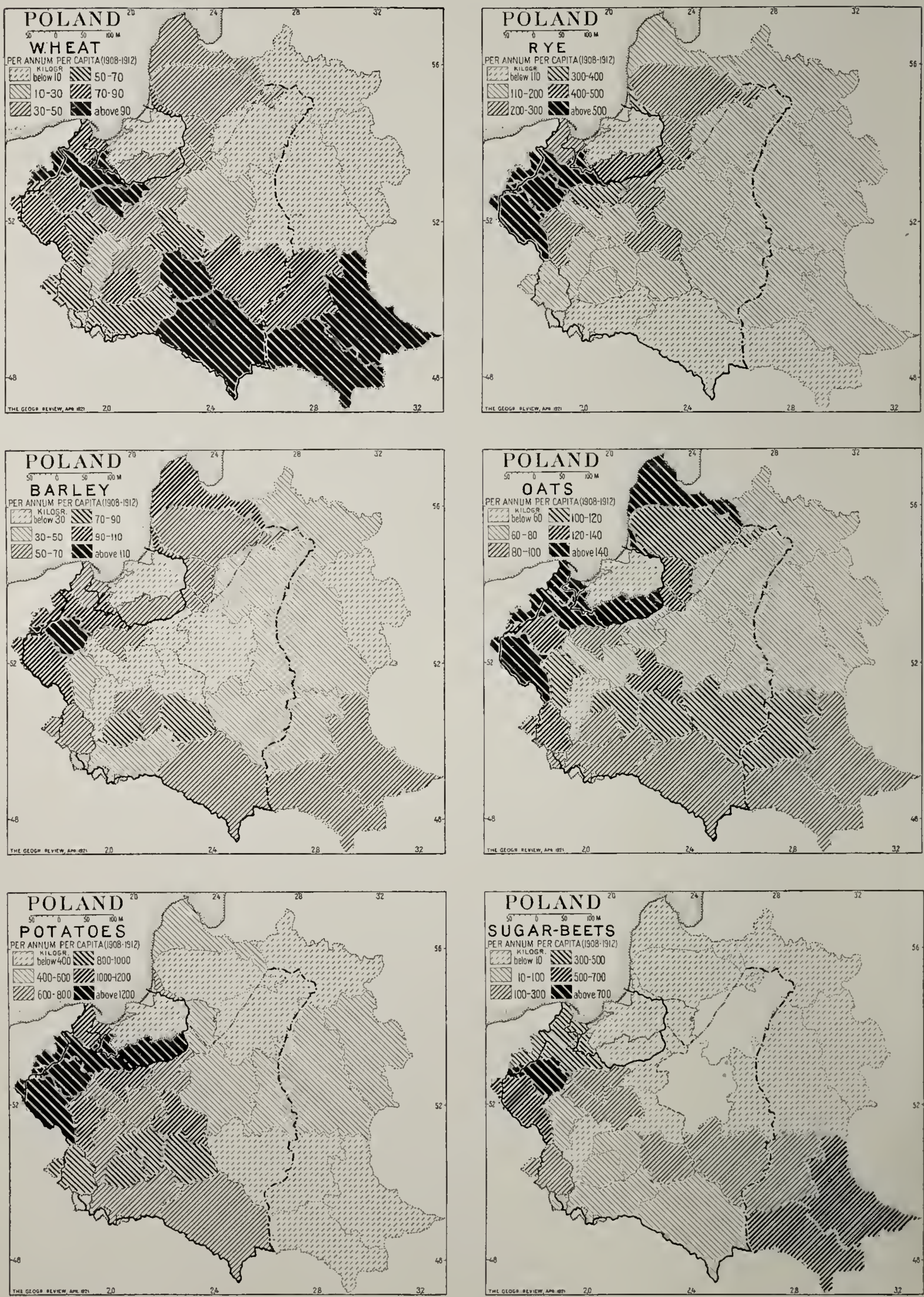

FIG. 2—Distribution maps showing production of food crops per annum per capita. The figures are based on crop statistics for the years 1908–1912 and population for 1910. The maps exhibit in striking fashion the high relative productivity of former Prussian Poland especially in contrast with the northeastern area, a fact to be explained largely in terms of superior administration and agronomics.

	WHEAT			RYE		
	Mean annual production in 100,000 kg.	Yield in kg. per ha.	Production per annum per capita in kg.	Mean annual production in 100,000 kg.	Yield in kg. per ha.	Production per annum per capita in kg.
Posen	1,050	2,108	78	7,133	1,753	534
Bromberg	638	2,074	84	4,338	1,742	568
Danzig	600	2,488	81	1,573	1,595	212
Marienwerder	1,099	2,074	114	4,881	1,637	508
Cracow	1,348	1,087	50	2,912	1,115	108
Lemberg	5,260	1,276	99	5,558	1,249	104
Congress Poland	6,198	1,233	51	22,289	1,055	184
Vilna	103	669	5	3,410	676	173
Grodno	229	908	12	3,306	781	169
Volhynia	3,031	1,062	79	5,847	901	152
Upper Silesia	1,128	1,850	51	3,127	1,675	142
Total area	20,684	——	61	64,374	——	190

	BARLEY			OATS		
	Mean annual production in 100,000 kg.	Yield in kg. per ha.	Production per annum per capita in kg.	Mean annual production in 100,000 kg.	Yield in kg. per ha.	Production per annum per capita in kg.
Posen	1,301	2,018	97	1,982	1,912	148
Bromberg	1,044	2,044	137	926	1,814	121
Danzig	518	2,409	70	1,263	1,973	170
Marienwerder	1,043	1,999	109	1,726	1,767	180
Cracow	1,150	1,068	43	2,602	1,039	97
Lemberg	2,778	1,171	52	4,905	1,120	92
Congress Poland	5,647	1,123	46	10,582	920	87
Vilna	689	679	34	1,398	633	70
Grodno	410	766	21	1,281	659	66
Volhynia	1,682	910	44	3,943	907	102
Upper Silesia	1,202	2,065	54	2,659	1,935	120
Total area	17,464	——	51	33,267	——	98

	POTATOES			SUGAR BEETS		
	Mean annual production in 100,000 kg.	Yield in kg. per ha.	Production per annum per capita in kg.	Mean annual production in 100,000 kg.	Yield in kg. per ha.	Production per annum per capita in kg.
Posen	28,579	15,018	2,139	7,308	27,956	547
Bromberg	14,462	14,293	1,893	6,433	26,120	842
Danzig	7,485	13,279	1,008	2,402	27,369	323
Marienwerder	19,228	13,931	2,001	4,521	27,154	471
Cracow	17,418	9,813	648	291	24,365	11
Lemberg	42,278	12,749	792	980	21,121	18
Congress Poland	100,818	9,643	831	13,624	14,796	112
Vilna	7,565	6,191	379	——	——	——
Grodno	7,845	6,460	402	——	——	——
Volhynia	12,253	7,833	319	5,278	14,879	137
Upper Silesia	18,699	13,819	847	3,655	28,256	166
Total area	276,630	——	814	44,492	——	(sugar) 20

There is also a surplus in the production of barley (6 kilograms per capita), and the potato crop is certainly very much above the requirement.

Reasons for Increased Production in the Future

This summary of statistical data leaves no doubt that in agricultural production the Republic of Poland is a self-sustaining country. But this

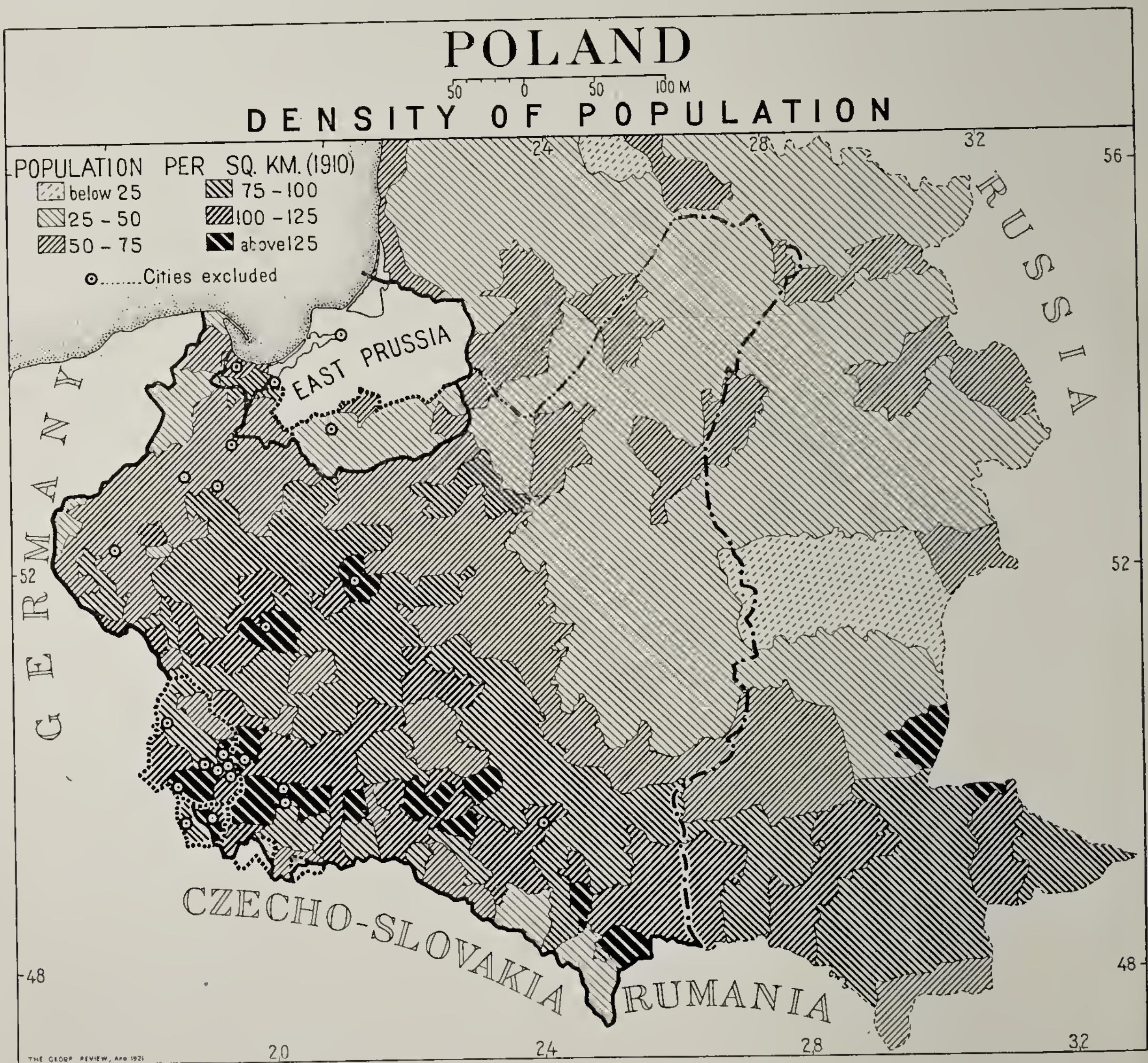

FIG. 3—The density of population in Poland in 1910. As a consequence of the war great changes have taken place in eastern Poland. In some of the districts of the governments of Grodno and Minsk the decrease of population is estimated at 50 per cent or more. Thus the marked difference between the density of population in eastern and southern (foothills of the Carpathians) Poland has been still further accentuated.

is not all. Poland is in a dynamic state of transformation, reconstruction, and improvement. Progress is inevitable; agricultural production must increase, as the following considerations will demonstrate.

The boundary lines that divided Poland among the three former Empires of Russia, Germany, and Austria no longer existing, the imprint of the Russian, Prussian, and Austrian administrations will gradually disappear.

Differences of soil and climate are not sufficient to explain the contrast in the figures 2,108, 1,276, and 669, which express the yield of wheat, in kilo-

grams per hectare, respectively in Posen, Eastern Galicia, and the Government of Vilna, that is to say in the western, southern, and northeastern parts of the country. These figures show the imprint of Prussian, Austrian, and Russian administration, and their difference is mainly due to greater or less progress; proper administration in one case and lack of administration in the other. Simple comparison of these three figures shows the vital importance of the readjustment problems to the new political and economic conditions.

On the other hand, we have a case of encouraging progress from the area within the triangle formed by the above-cited provinces, that is in Congress Poland. While the population was 8,256,562 in 1890 and 12,776,100 in 1912, an increase of 4,519,538 or, let us say 50 per cent, agricultural progress was much more rapid. The production of each of the principal crops—wheat, rye, barley, oats, and potatoes—more than doubled in the same length of time. Increase in relation to increased population is shown in Table III.

TABLE III—INCREASE OF AGRICULTURAL PRODUCTION IN RELATION TO INCREASE OF POPULATION

(Figures in puds per capita: 1 pud = 16.38 kilograms)

	WHEAT	RYE	BARLEY	OATS	POTATOES
1890	2.46	8.50	1.99	4.17	37.63
1912	3.20	11.53	3.05	5.60	53.48

The graphic representation of annual data displays the continuous progress made therein. Furthermore, it must be remembered that the yield is still very inferior. In spite of the progress achieved an "abyss," as Romer terms it, separates the agricultural yield of the late Russian and Austrian from that of Prussian Poland. Thus the yield per hectare (1908–1912) of wheat is 2,108 kilograms in Posen and only 1,233 kilograms in Congress Poland, and like differences obtain in respect of all other crops. For the yield in Congress Poland to reach much higher figures is only a question of skill and organization, of better agricultural implements, and the extensive use of artificial fertilizers, potash in particular. In regard to the last point it may be noted that Poland's resources include the potash deposits of Kalusz, Szubin, and other localities.

CHARACTER OF THE OCCUPATION OF THE LAND

Progress also lies in agrarian reform. Up to the present a great part of the land, especially in the east, has been held by a comparatively small number of large landowners. Some landowners have left their properties uncultivated or have cultivated only a restricted area, and the rural population of overcrowded districts has been obliged to emigrate because of lack of land. At present 40 per cent of the total area of Poland, or about 12,000,-

000 hectares, is owned by approximately 18,000 landowners. On the other hand, in some of the small, densely populated districts of Galicia—with over 125 inhabitants per square kilometer—the rural population exceeds 18,000 on less than 18,000 hectares of land.

The figures for areas under the principal crops are significant. I have added them for wheat, rye, barley, oats, potatoes, and sugar beets, expressing the result in percentage of the total area. Remarkable differences between the different provinces are shown. The extreme values are: Posen 47 and Grodno 21. The value for Congress Poland is 43, for Eastern Galicia 34. These figures may be compared with data showing the general occupation of the land.

Table IV—Occupation of the Land
(*Percentages*)

	Posen (1913) *	Grodno (1887) †
Area occupied by buildings	1.0	4.2
Arable land and gardens	64.6	39.7
Meadows and pastures	9.9	19.6
Forests	19.9	23.7
Waste land	0.9	12.8

* *Statistisch Korrespondenz*, Berlin, Vol. 41, 1915, No. 19, p. 2
† *Svod statistischeskikh Svyedyeni, Minist. Zeml. i Gosud.*, St. Petersburg, 1902, Vol. 1, p. 35.

The 47 per cent cited above for the principal crops in Posen leaves, therefore, only 17 per cent of land for other crops and gardens. For the Government of Grodno unfortunately there are no recent statistics available. However, if in 1887 the arable land occupied 39.7 per cent of the total area, we may presume that the figure for 1910 would be at least 5 per cent higher. If so, the 21 per cent of the total area used for wheat, rye, barley, oats, and potatoes would leave 20 to 25 per cent for flax, vegetables, fruit gardens, etc.—which seems abnormal. The 4.2 per cent given for buildings is likewise extravagant. The area now occupied by forests is evidently much less than 23.7 per cent. The 19.6 per cent of meadows should be reduced, and some of the 12.8 per cent of swamp land could be reclaimed and transformed into pasture land. Compare now the yield of crops as shown by Table V.

Table V—Yield of Principal Crops
(*Kilograms per hectare*)

	Posen	Grodno
Wheat	2,108	908
Rye	1,753	781
Barley	2,018	766
Oats	1,912	659
Potatoes	15,918	6,460

It is true that the soil of Grodno does not compare with the soil of Posen, nor is the climate, with its long winter season, as favorable. It is in fact customary for the arable land to be left fallow every third, fourth, or fifth year. But the application of the land-reform bill will bring new possibilities into the region of Grodno; more land will be cultivated and probably under better conditions.

Changes in Population Density

With agrarian reform accomplished, the question of labor takes on new aspects and the population density map new interest. The map expressing the distribution of density of population (Fig. 3) was drawn with more detail than the other maps. Instead of showing figures for provinces, or governments, it shows figures for the smaller administrative divisions, mainly to illustrate the abnormal concentration of the rural population along the foothills of the Carpathians.

If the changes that have occurred as a direct consequence of the war could have been mapped, the great difference in density of population between Galicia and the eastern and northeastern provinces of Poland would have been even more accentuated.

The decrease in population of the northeastern districts of Poland, due principally to the Russian evacuation of 1915, is given in Table VI. To simplify comparison the districts are grouped in rows, running from southwest to northeast.

Table VI—Recent Decrease of Population in Northeastern Districts of Poland*

District	Percentage of Loss	Number of Inhabitants per Square Kilometer in 1910
Government of Vilna		
Troki	47	41
Vilna	25	71
Swieciany	22	39
Governments of Grodno and Vilna		
Grodno	47	56
Lida	26	45
Oszmiana	31	41
Wilejka	14	40
Governments of Grodno and Minsk		
Brzesc-Litewski (Brest-Litovsk)	68	53
Pruzany	61	41
Slonim	55	40
Novogrodek	37	60
Minsk	13	66

* The figures are from a manuscript official document.

Since similar changes occurred also in Volhynia, in the Chelm region, and in Eastern Galicia and since only a small percentage of those who were evacuated and are still alive will ever return, it may be understood that the present contrast of density of population between the southwest and west of Poland and the northeast and east is in reality much more pronounced than appears on the map and that, because of this fact, the surplus of the rural population of the southwest will naturally trend towards the east.

Of course the organization of a systematic migration of from 2,000,000 to 3,000,000 people from one part of the country to another would solve the

Fig. 4.—The distribution of forests.

problem. But, since the application of any such drastic method is out of question, it seems that agrarian reform should be relied upon to provide the necessary stimulus.

Provisions of the Land-Reform Bill

An agrarian reform bill was voted by the Diet on July 15, 1920. In abstract, this bill authorizes the General Land Office, already organized, to proceed with the parcelment of the government-owned land and such lands as belonged to the former Russian Peasants Bank and to the former Prussian Colonization Commission. Furthermore, the Land Office has the right of expropriation in the following cases: administrative mismanagement; parcelment without government authorization; disposition of land bought between August 1, 1914, and September 14, 1919, by persons other than professional farmers, of properties which during the last five years have changed hands more than twice, of land acquired by war profiteers, of land in the neighborhood of towns or industrial centers, and of farms destroyed during the war which could not be reconstructed by the landholders.

An area of 60 hectares will be the largest allotment for suburban rural properties as is also the case for the neighborhood of industrial centers. In the former Prussian provinces and in eastern Poland 400 hectares is the

maximum, while everywhere else only 180 hectares are allowed to each farm. A landowner has the right to possess only one farm. However, exceptions will be made where the parcelment of large and well managed properties would be detrimental to the interests of the country. The same provision applies to stock and seed farms.

Other provisions of the bill concern the valuation of the land expropriated, agricultural schools, model farms, etc.

In the purchase and recolonization of the land priority will be given first to wounded soldiers of the war, then to farm laborers thrown out of employment by the parcelment of the large estates and to the small landholders of the surrounding country.

The land-reform bill will specially aid in the opening up of the north-eastern provinces—now backward and sparsely populated—to the more enterprising and progressive farmers and peasants of Galicia. The peasants, however, cannot settle in the devastated country without provision being made for housing and supplying them with the necessary farm stock and implements. If agricultural machinery, tractors, and farm animals were available, the migration of the people from one part of the country to another could be organized on a large scale, and the improvement would be rapid. Thus the progress made will depend primarily on the means placed at the disposal of the Polish Government.

PHYSIOGRAPHY AND SETTLEMENTS IN SOUTHERN MACEDONIA

By Alan G. Ogilvie

[With Fig. 4 on Pl. II facing p. 178 and separate map, Pl. III facing p. 196]

In a previous paper[1] an attempt was made to elucidate in a general way the geographic basis of life in a section of Macedonia, and the discussion of the physical controls included a brief description of the land forms. Throughout the history of man in the Balkan Peninsula such a powerful influence has been exerted by the peculiar conditions of relief, and of soil and water distribution, that it seems to be worth while to emphasize at greater length in the present paper the character of these features and the human response to them; for, while the examination deals with but a small section of the Peninsula, the physiography of this region may be taken as typical of large tracts between the lower Danube and the Aegean.

As explained in the former paper, the nature of my military duties in Macedonia precluded any thorough physiographic investigation; but I was called upon to make a number of journeys—mostly rapid—in many directions throughout the area. Moreover, the detailed mapping of the country for military purposes[2] has permitted a more thorough study of the relief than has hitherto been possible. In so far, then, as the description of the landscape given below is explanatory, it is intended to be suggestive and in no sense final. My statements regardlng the geology of the region are largely taken from the work of others (see appendix)—of the most of which I was ignorant when in the country; but I believe that my physiographic deductions, based partly on the previous work but mainly upon my own observations of the topographic features, may be of service to the geologist, who in the future will be able to treat of the subject after making a thorough geological survey. The present geographical paper only points to probable geological causes as a help to the description of the topographic features.

The outstanding topographic features of the region are plateaus and flood plains. The plateaus exhibit a great variety of shapes in plan. Their surfaces are due partly to erosion and partly to deposition, and they are more or less dissected. Their edges are largely straight and are always abrupt. The flood plains which separate the plateaus are isolated save for narrow defiles which connect them. They are partly filled by lakes or by marshes—the relics of former lakes.

[1] "A Contribution to the Geography of Macedonia," *Geogr. Journ.*, Vol. 55, 1920, pp. 1–34.

[2] The maps made during the war cover all the region north of the latitude of Saloniki. For most of Khalkidhike I had no adequate map, and my plotting of features there cannot be regarded as accurate.

The Rocks

All of the high land and parts of the lower plateaus are underlain by rocks which are transitional in character between the purely crystalline of the Rhodope to the northeast and the sediments of the Dinaric ranges to the west. The most extensive outcrops are of green chlorite schists with veins of quartz, serpentine, etc., belts of gneiss and important bands of limestone, gray to white in color, and showing all degrees of alteration up to the white marble which composes most of the pyramid of Mt. Athos. In the eastern part of Khalkidhike there are two lens-shaped outcrops of a granite, so much disintegrated as to be relatively weak in resisting erosion. Along the major faults which run southeast from Saloniki—and probably on other faults also—are notable bosses of basic intrusive rocks, mostly gabbro and diorite. On the higher plateaus there are large stretches covered by a red residual clay, which bears witness to the long period of erosion to which these surfaces are due.

The lowland corresponds mainly to the areas of clay left by the so-called Sarmatic sea—a huge fresh-water body which formerly covered the whole region—or of beds of gravel, sand, and fresh-water limestone deposited in the gradually shrinking lakes of the separate basins. The flood plains also contain important belts of alluvium, and, bordering the highest escarpments, there are large alluvial fans of well graded materials.

Their Structure and Relation to Relief

It will be seen below that difference of rock outcrop does not account for the largest features of relief. But in the uplands relative strength of the rocks has been an important factor in determining the highest residual ridges as also in locating the valleys more recently incised in the older surfaces. Generally the limestones and gneisses form ridges in all parts, and the pale limestone crags form a characteristic feature along a belt running from Dub (above Doiran) southeastward with numerous gaps through Deve Kran, Khortach Dagh, Kholomon Vuni, and northern Longos to Mt. Athos.

In many parts of the Rhodope massif the metamorphic rocks exhibit a west-southwest–east-northeast strike, and in the eastern part of our region the rock outcrops frequently have this trend. Throughout the bulk of the area, however, the strike varies but little from the northwest-southeast direction. This is the trend of the Dinaric Alps to the west of the zone in question. The two strikes come into active conflict in the Krusha Balkan, eastern Beshik Dagh, eastern Khalkidhike, and the peninsulas of Athos and Longos. One result of the conflict may have been the foundering of the basins which lie on the margins of those areas. Otherwise the rock structure has had but little effect on the topography, save that differential erosion has etched the surface of the plateaus, as mentioned above, and that in consequence many of the minor watercourses and a few of the more important are "strike streams."

The most outstanding feature of the Macedonian landscape, the contrast between plateau and plain, has now to be discussed in the light of its origin. Briefly it is a legacy from the end of the Tertiary and beginning of the Quaternary periods when the whole of the central Balkan Peninsula was convulsed and rent by crustal disturbances which culminated in the depression of the Aegean basin—previously a land area and probably similar to the remaining highlands—which formed the southern rim of the Sarmatic lake. By these convulsive movements the entire rock base of our region became partitioned into blocks, some of which sank while others rose or remained stationary. Of these blocks the former correspond to the basins, the latter to the plateaus. The separate basins continued to hold water, and as the level of this gradually sank the lakes became isolated.

I have stated that the edges of the plateaus are abrupt and straight. They are indeed probably fault scarps in nearly every case, and, while they are deeply notched by streams, the ends of the spurs are in alignment. Their foot is frequently marked by a line of mineral springs of varying temperature, and in some cases bosses of igneous intrusive rock stand forward from the scarp like bastions. The scarps in the majority of cases truncate the various rock outcrops. In other words direction of scarp and direction of strike rarely coincide. It will be seen, then, that the greater features of relief, the block plateaus and the basins, are due not to normal processes of denudation but to the breaking up of the crust at a period so recent that subsequent processes have as yet altered the form given to the region in very small degree.

A close study of the relief reveals the fact that the outlines of the various plateaus and plains form a remarkable pattern in which there are many parallel sides, while the prolongation of a line bounding the foot of one escarpment is often found to lie along the foot of another escarpment. Many lines of this character have been drawn on the map—where they are described as "supposed fault lines." In few cases have I had the opportunity of proving their existence geologically. The lines have been drawn mainly from topographic considerations, and, where normal processes of erosion are regarded as insufficient to account for existing relief, the aid of recent faulting is invoked. In many cases this evidence is strengthened by the existence of warm springs on or near the lines as drawn or by reports of earthquakes in their vicinity.

A more detailed discussion of the fault lines will be found in the appendix.

Geographic Subdivisions

The proper subdivision of the region for geographic discussion corresponds to the groups of block plateaus and basins; and in the description of landscapes and human settlements given below this scheme is followed.

The map (Fig. 1) shows the outline of these main groups as well as that of interior topographic divisions to be referred to later. The highest blocks

are indicated by a plus sign and the lowest by a minus sign. The arrows indicate the probable direction of initial tilt in some of the blocks.

The first group of high plateaus, "A" (map, Fig. 1), occupies the northern and eastern limits of the region and contains in the Belashitsa Mountains the highest land (2,175 meters) in the region. As we are concerned only with the edges of these plateaus they will be dealt with along with the trough which they overlook.

Fig. 1—Key map to crustal blocks and physiographic divisions.

The plateaus and basins of the Vardar, "B." This comprises the basins of Gevgeli and the Saloniki Campagna separated by a rather complex system of small and mostly low plateaus.

The Krusha-Beshik plateaus, "C," with small included basins form the largest block mountain system in the region. It extends from Lake Doiran southeastwards across the mouth of the Struma.

The Doiran-Struma trough, "D," lying between groups "A" and "C."

The Khalkidhike group, "E," is made up of a complex system of alternating block mountains and basins with the prong of the Khortach Dagh extending northwest and the three fingers extending southeast.

The Langadhá-Beshik trough,[3] "F," lying between groups "C" and "E."

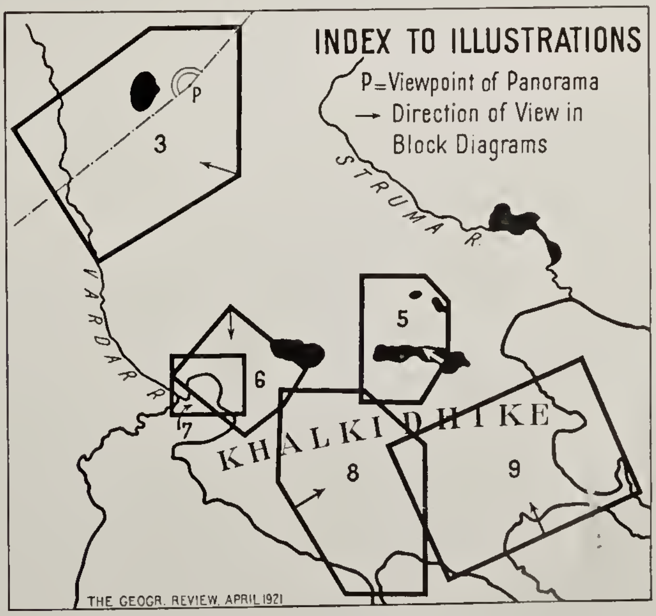

Fig. 2

The Plateaus

The plateaus then are upon fault blocks, and many of these are tilted, so that each has a steeper and a gentler slope. Their surfaces bear traces of long periods of erosion prior to their separation by faulting, and there is a remarkable accordance of level over wide tracts. The study of these

[3] Accents, in this article, indicate the stressed syllable.

relatively smooth surfaces is important both to the geologist who attempts to trace the physical history of the region and to the geographer, since the distribution of the population is largely determined by that of the available smooth surface. The most outstanding features of this kind are shown by tints on the map.

Briefly there are four well marked surfaces, of which the two older—and the higher—lie on the upraised blocks and largely on crystalline rocks.

The Lake Terraces

The two younger surfaces may perhaps be best described as lake terraces, for they are found round the margins of the basins or on the slightly raised blocks which must have stood as shallows, with islands gradually emerging from the waters of the shrinking lakes. These lower surfaces are evidently due mainly to sedimentation and wave action. They consist largely of clays and sands, and the small amount of dissection which they have undergone points to their recent origin. For convenience of reference I shall speak of them as the terraces, upper and lower. The upper terrace varies between 280 and 240 meters in altitude. It has been identified at intervals all along the southwestern border of the Krusha Balkan block and on the northern side of Khalkidhike, as well as east of the Struma mouth and west of the lower Vardar. The lower terrace lies between the 180 and 140 meter contours and is found on both sides of the lower Vardar valley.

The Upper and Lower Peneplains

The two higher surfaces appear to be due mainly to the normal processes of erosion and aggradation. For convenience I shall refer to them as the upper and lower peneplains. Further research on the ground may assign them to a single period; but there is in many places a marked break between the surfaces which may well indicate an interruption in the topographic cycle. Each of the peneplains appears to be highest in the northwest and lowest in the southeast, the higher ranging from about 780 to 480 meters, and the lower from about 420 to 320.

The higher peneplain forms the summits of the spurs of the Belashitsa north of Lake Doiran and of the western part of the Krusha Balkan. It then widens southeastwards to the great saddle between the Krusha and Beshik blocks. This saddle of Láhana lies in a direct line between the gorge at the eastern end of the Belashitsa, where the Struma breaks through that range, and the pass "Dervend" in the Khortach block five miles north of Saloniki, which is undoubtedly the remains of a river valley. This fact led Cvijić with good reason to interpret both features as the work of an older Struma. But in each case the valley trend was probably determined by fault line weaknesses. The peneplain is also well developed south of Beshik Dagh and on all the higher blocks of Khalkidhike, where it has a very uniform altitude of about 500 meters. It is perhaps the most striking feature

in the region although it is now dissected to a much greater extent than can be shown on a small-scale map. Its remnants are of the greatest importance to the population, as will be seen below.

The remnants of the lower peneplain are most continuous on the southwestern side of the Krusha and Beshik blocks, but it has also been identified on the block mountains of Khalkidhike. It ranges from about 420 to 320 meters in altitude, possibly lower in southeastern Khalkidhike. It is more dissected than the higher peneplain except where it reaches back from the margins of the blocks, as at the headwaters of the Galiko and in the enclosed basin of Mávrovo where it is a surface of aggradation.

Above the highest peneplain there rise the crests of the block mountains. While the rocks forming these represent the roots of some older mountain system, they are now simply residual ridges on the higher peneplain. They fall into four groups: the Belashitsa Planina; Krusha Balkan and Beshik Dagh; the Khortach, Kholomon, and Stratonikon ridges in Khalkidhike; and the crests of the two fingers of Longos and Athos.

The parts of the map which remain untinted are either the wide alluvial flats of the basins, often ill-drained and containing the various lakes and marshes; or else they represent slopes between the plateaus or regions too much dissected for plateaus to be recognizable. I did not visit the southwestern part of Khalkidhike and the two western fingers, so these areas are left untinted.

The Doiran-Struma Trough

This important depression falls naturally into western and eastern sections. The western section is narrow—from three to ten kilometers wide—and is walled on the north by the abrupt and almost straight fault scarp of the Belashitsa range and on the south by the deeply dissected slopes of the Krusha Balkan, only less steep than the northern wall (see Figs. 3 and 4.) It is a funnel very difficult of access from either wall. Its western extremity is occupied by Lake Doiran, almost circular and flat-bottomed, beyond which it is all but hemmed in by the low plateaus of the Vardar. While the bed of the funnel bears traces in its alluvial deposits of a former river draining a greater Doiran to the Struma, the watershed is now situated ten kilometers east of the lake and some 100 meters above it. This is the col of Dova Tepe, above which on a spur to the south stands the modern fort of that name.

The Belashitsa front exhibits three distinct surfaces. The highest part is smooth, very steep, and bare of trees. It represents a residual ridge on the highest peneplain. At from 300 to 400 meters below the crest project a series of gently sloping spurs offering summer pastures. These are relics of the highest peneplain. They are separated by deep gullies covered with deciduous scrub or forest. The spurs themselves end in abrupt bare facets—parts of the fault scarp proper. The main gullies are fronted by large alluvial fans, which continue to be built up while the smaller streams from

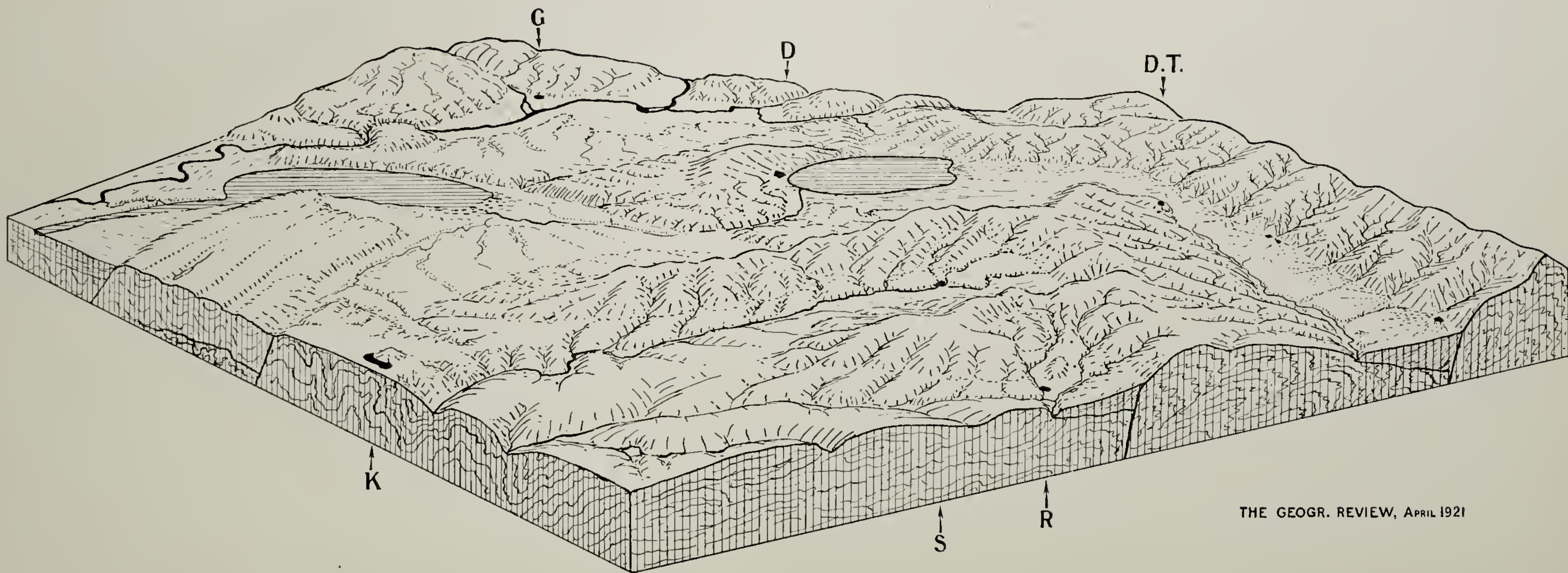

Fig. 3—Vardar plateaus, Krusha Balkan, and Belashitsa Range. On the left the Vardar River passes from the basin of Gevgeli (G) through the Gipsy Defile, in front of which is Lake Arjan. In the center the Vardar plateaus occupy the background, the Dub ridge overlooking the town (D) and lake of Doiran. From this the trough extends to the right over the col and fort (D.T.) of Dova Tepe, and so to the drainage basin of the Struma. The faceted scarp of the Belashitsa forms the northern (right) edge of the diagram. The foreground is occupied by the Krusha Balkan with its short northern and long southern slopes, the latter constituting the Galiko drainage area, the head streams gathering in the two depressions of Snevche (S) and Rayánovo (R). Parts of the two lake terraces are seen in the left foreground, on the higher of which is Kukush (K). Only a small proportion of the villages are shown in the diagram. The faults on this and other figures are shown diagrammatically; the amount of throw and hade being unknown.

Fig. 4—Panorama from a northwestern spur of the Krusha Balkan taken about midwinter. For extent see Fig. 2.

Top panel: In the background, the mountains of Payik (left) and Meglen (right), lying between the Vardar and Cherna valleys. It was along this ridge that the Serbian army finally broke through. In the foreground, the lake and town of Doiran backed by the Dub ridge, seen in elevation. The Bulgarian army occupied the summit of this ridge for over two years.

Center panel: Portion of higher peneplain with main Bulgarian defense system on the fault scarp (left); western end of Belashitsa Planina (right); zone of villages across the trough (left foreground).

Bottom panel: Part of Belashitsa Planina with fault scarp marked by facetted spurs; irrigated alluvial fans in foreground.

the spurs have incised their beds in the fans. The rivers draining the trough to the east and the west hug the southern rim, forced thither by the fans.

The village sites are of two types characteristically placed in relation to the alluvial fans.[4] The first group, consisting of large villages, lies close up to the fault scarp, each village at the apex of a fan, commanding the water which is diverted into hundreds of irrigation channels radiating on the fan. The other group occupies a zone stretching across the trough at the lower edge of the fans where the ground water emerges, but above the swampy zone around Lake Doiran. These villages are small, but there are eleven of them in the zone between the trough walls, which are here six kilometers apart. The small town of Doiran stands majestically on the southern shore of the lake, built partly on a narrow terrace and partly on the steep slope of the Dub ridge. The site, which controls traffic on the old road from the Aegean to the upper Vardar, has been occupied since very early times. The town, which normally has over 3,000 inhabitants, has always provided the bulk of the lake fishermen.

The eastern portion of the trough differs from the western mainly in its much greater length—about 80 kilometers—and breadth—about 12 kilometers on the average—and in the flatness of its floor. Its northern wall, the Belashitsa, has characteristics similar to those of its western section. The northeastern wall consists of high mountain blocks cut by deep gorges; but throughout most of the length a much-dissected lake terrace, widest in the east, intervenes between wall and plain. This terrace is also found in the south, but not along the western wall, which is abrupt and cut by numerous canyons, many of which are impassable.

The only routes by which the basin is easily accessible are the western funnel, by which the railway enters it; the saddle (east of the region) by which it leaves, leading to Drama and Constantinople; the deep defile by which the Struma enters from the north and the much shallower defile by which it seeks the sea; the Láhana saddle, central on the southwestern wall; and a higher saddle central on the northeastern wall. Each of these is followed by a road.

The whole basin is rimmed by alluvial fans; and, as the more important streams come from north and east, the Struma is forced towards the southwestern wall. This river itself fills the northeastern corner with a large, flat fan which dams the waters of the western funnel, forming the lake and swamps of Bútkova.

This lower Struma plain is one of the most important agricultural areas in Macedonia, and most of its surface is under permanent cultivation. The population—mainly Slav in the north and Greek in the south—occupies villages whose size corresponds generally to the fertility of the soil. Again, we find one group at the tops of the fans—the town of Seres being by far the biggest of these, another set of large villages farther out and drawing their water mostly from shallow wells, and a third group of small places close to

[4] The map showing settlements (Fig. 10) may be consulted. The map is discussed on pp. 193–195.

the marshes. A notable feature of the landscape of the plain is the clumps of magnificent elm trees grouped about the villages, which give much needed shade in summer and provide nesting places for the storks.

The southern extremity contains the last remnant of a great lake. But the shallow Ahinos is fast filling up and could now be artificially drained with little difficulty. The small loss to the fisherman would be amply repaid by the gain to agriculture and the removal of the curse of malaria.

The study of population density is instructive in this plain where every foot of cultivable land is utilized; and it is safe to assume that the statistics of 1905—which happen to be available—show approximately the population which such land can support with the local methods of agriculture. In the map illustrating the distribution of settlements (Fig. 10) I have outlined the plain and divided it into two zones, the first (A) including the fans and drier belt, the second (B) covering the wetter ground but omitting the lake and swamps. The population per square kilometer in zone A is 217 and in zone B 66, or 561 and 170 per square mile respectively. In the computation one-half of the population of Seres, or 4,650, was disregarded, as being not directly dependent on the land of the plain.

The Krusha-Beshik Blocks

This highland area extends for 100 kilometers from northwest to southeast with an average breadth of nearly 30 kilometers. The highest parts of the Krusha Balkan lie on two blocks set nearly at right angles to each other (Fig. 1). These overlook—on the south and west—a large triangular block with its apex to the south and corresponding to the drainage basin of the Galiko River (Fig. 3). Before the scarp of the northern high block there are the two smaller triangular basins of Snevche and Rayánovo. Of the two high blocks the western has a narrow crest with a fairly uniform altitude of about 700 meters, while the eastern contains a wide stretch of the highest peneplain and has residual ridges rising to 1,175 meters. These high crests are covered with deciduous forest. The Galiko and its tributaries, while they are separated by a number of steep and rocky spurs, flow for the most part in valleys incised in the lower peneplain. There are therefore extensive smooth surfaces, with much residual clay, almost entirely cleared of forest and given up to intermittent agriculture. But the steep valley sides are covered with brush and are difficult to cross. The basins of Snevche and Rayánovo are filled with a thick red clay deposit which the streams have somewhat dissected. Here the agriculture is permanent.

The valleys of the Galiko and its main tributary, the Spanc, contain a few relatively important villages. Otherwise the most striking feature in the distribution of settlements is the bunching of small villages in a few areas, which are frequently so broken by gullies that the extent of cultivable soil cannot have been the attraction. The reason for the close grouping of the villages may lie in the need for their original inhabitants to combine

for defense. This at least would seem to be the case in the groups east of the Galiko, which are Turkish: every hamlet is so placed that all windows can command the approaches, which are usually steep and narrow.

The most astonishing village swarm occurs on the northern slope of the Krusha Balkan, where there are 48 situated in an area of about 125 square kilometers, or between two and three per square kilometer. Of course these villages are small, but the slope is steep—it falls 600 meters in some three and a half kilometers. The explanation probably is that the natives obtain a livelihood by farming in the trough below; but, as the villages were evacuated during the war, I could not find out if this was actually so. At the southwestern edge of the lower block and overlooking the Vardar basin is a wide patch of the higher lake terrace with edges falling steeply

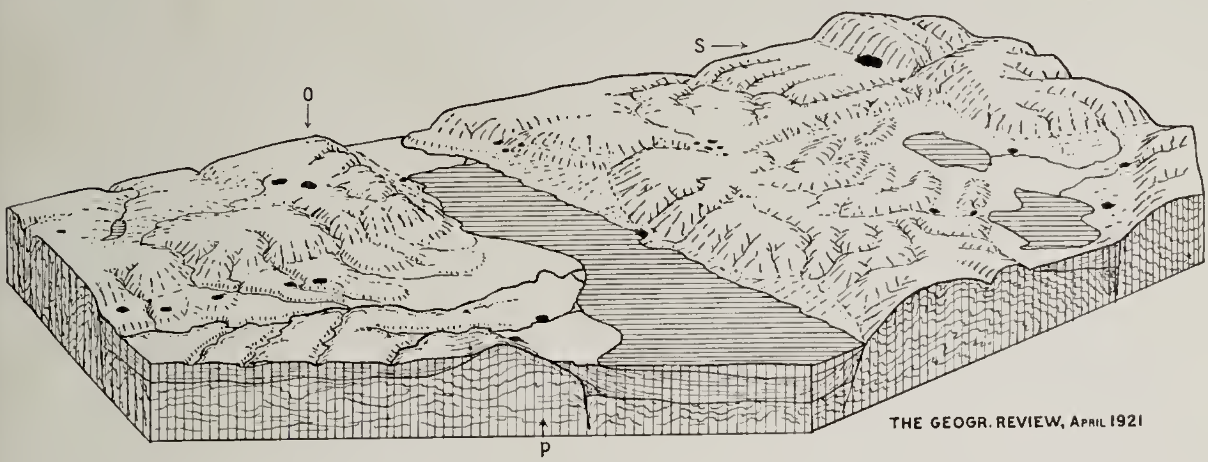

FIG. 5—Lake Beshik area. On the left, the plateau of Ogurli (O) and terraced valley of Koja Dere with Pazarkia (P) on the delta; on the right, summits of Beshik Dagh behind, with Suho (S), Mávrovo enclosed basin with lakes in front. All the settlements are shown.

away on three sides. At its center is a butte—a miniature relic of the lower peneplain. On the butte is a church, and at the foot of the butte lies the town of Kukush (Kilkish) formerly with some 10,000 inhabitants. It derives its importance from its nodal position and is a collecting center for the produce of the plateaus to the north of it.

Between the Krusha and Beshik Mountains lies a continuous stretch of the higher peneplain broken by the deep ravines of the rivers which run northeast and southwest from the saddle of Láhana. Except for the steep ravines, which are scrub-covered, all of this plateau is marked by intermittent cultivation. Its chief geographical importance is as a route, and it must have served in this way for many centuries. One of the few prehistoric sites away from the basins is found near the village of Bérovo and 14 kilometers from the plain, while the remains of an important classical Greek town lie at the junction of the route with the Struma valley. The existing villages are remarkable for their size. They are wide apart and consequently the farmers travel far to their fields.

The two masses of the Beshik Dagh contain the widest areas of land above the high peneplain in the region. These summits are entirely covered with

deciduous forest or brush. The scarps facing south and west are precipitous, while the northern slopes are very deeply dissected and have an extremely small population. Between the high scarps and the Beshik Lake the surfaces of the two peneplains are wide and little dissected, and they have mostly been cultivated at one time or another (Fig. 5). The only access to these plateaus is by difficult trails up the fault scarp from the south and through the gap north of Mávrovo. The small basin in the eastern part was formerly drained to the southeast, but the two small lakes Mávrovo and Lanja now have no outlet. The plateau is dominated by Suho, a large, closely built village of over 4,000 inhabitants which stands at the upper edge close under the high scarp; the other villages are small.

The rugged block of the Beshik Dagh has two extensions, one eastward joining it to the Bunar mountains, beyond the region; the other, southward, linking it to the Khalkidhike. The first of these thresholds is severed by the Struma mouth. The river seems to have cut a wide valley across it at the level of the lower peneplain and then, since the subsidence of the Aegean basin, to have cut its existing narrow passage nearly to the sea level. The hill within the incised meander of the defile is the site of the ancient Greek city Amphipolis, the "City [with the river] about" [it], and before its foundation the site is mentioned (by Herodotus) as the "Nine Ways"—clearly a nodal point of importance. There are three passages through the southward extension of the Beshik block. Two of them are at high levels, 340 and 140 meters respectively, and may mark previous drainage outlets. The large village of Vrasta marks the point of their junction on the seaward side. The deep, wooded defile of Rendina carries the present drainage channel from Lake Beshik with a fall of only 20 meters from lake to sea.

The seaward scarps of the Beshik block mountains are abrupt and are scarcely dissected by the steep mountain torrents which seam them. The higher parts bear deciduous forest and bush while the lower slopes are clad in a luxuriant mantle of the Mediterranean *macchia*, which is here at its northern limit. There is a wide beach which carries fine groves of olive trees north of Vrasta and of planes about Stavros at the mouth of the Rendina.

The Langadhá-Beshik Trough

From its western threshold at Deve Kran this trough extends for 30 kilometers to the southeast with a nearly constant width of 10 kilometers. It then forks, the southeasterly direction being continued for another 20 kilometers at the level of the higher lake terrace, while the northern and deeper fork turns east-northeast for 10 kilometers with a width of 5 kilometers and then east for 23 kilometers more with a width of 10 kilometers. The trough is bounded almost everywhere by abrupt parallel fault scarps which lead directly to portions of the higher or lower peneplains. The forking above described is due to the isolation of a roughly triangular block, which I have called the Ogurli plateau from a village on its surface (Fig. 5). The

highest part of the block exhibits a portion of the higher peneplain still undissected and containing a small lake. This level area forms the farm land of two villages. The slopes are covered with bush. The lake terrace which extends from side to side in the southern fork of the Langadhá trough is nearly flat and carries a shallow lake which has no outlet but is in imminent danger of being drained either eastward or westward by the head streams which are cutting back from both sides. The terrace is cultivated intermittently over most of its surface, but there are extensive patches of high thorny *Paliurus* bush.

The same fault which isolates the Ogurli block seems to be responsible for two other features of importance. It has brought up the hard limestone which forms the abrupt toothlike crag of Deve Kran (570 meters) standing guardian of the western threshold of the trough, and it gives outlet to a constant supply of hot mineral waters east of Langadhá village, where throughout history the baths have attracted the Salonikans. This fault and those related to it formed the focus of important earthquakes as late as 1902.

The natural scrub vegetation of the trough walls is very sparse in the west but gets progressively more luxuriant eastward—an evidence of increasing humidity in that direction. All the bottom land, however, which is not swamp is cultivated and mainly without irrigation. The two residual lakes are very shallow except for the eastern part of Beshik, which is 22 meters deep. They contain considerable quantities of fish, and fishing provides occupation for several villages. The only outlet from Langadhá is an artificial canal. Except in the western end of the trough and in the flat delta which extends northward into Beshik, the villages are situated on the terraces or fans round the trough walls; and on the eastern side of the Ogurli block there is a line of six places built on consecutive patches of dissected lake terrace. The southern edge of the trough is the reputed route of the Via Egnatia, the Roman highway across the Balkan Peninsula; while the six prehistoric and two classical Greek sites hitherto identified bear witness to the long period of human occupation.

Khalkidhike

The high kernel of this peninsula consists of the long narrow blocks of the Khortach Dagh, extending from the Galiko River for 60 kilometers to the southwest, and the Kholomon Vuni, running northeast from the end of the Khortach Dagh for 20 kilometers and then after a gap continuing eastward as the Stratonikon Oros to the sea.

All of these have much land above the higher peneplain, and the two last named carry the most important deciduous forests in the region. To the southwest and south of these are several blocks at a lower elevation and tilted in various directions (see map, Fig. 1), while the three blocks forming the fingers can be considered as separate units. The Khortach blocks will

be discussed first, then western and eastern Khalkidhike in order, and finally the three fingers.

Khortach Dagh

The parallel sides of the block are fault scarps, and the block as a whole is a horst (Figs. 6 and 8). Cross faults at right angles to the others account first for the broken northwestern end of the block—a scarp of which the precipitous character is emphasized by the Galiko defile at its foot; secondly, for the sudden rise in elevation above the high peneplain seven kilometers east of Saloniki; and thirdly, in all probability for the hollow just north of the city and for the old river valley known as the Dervend or "pass" now

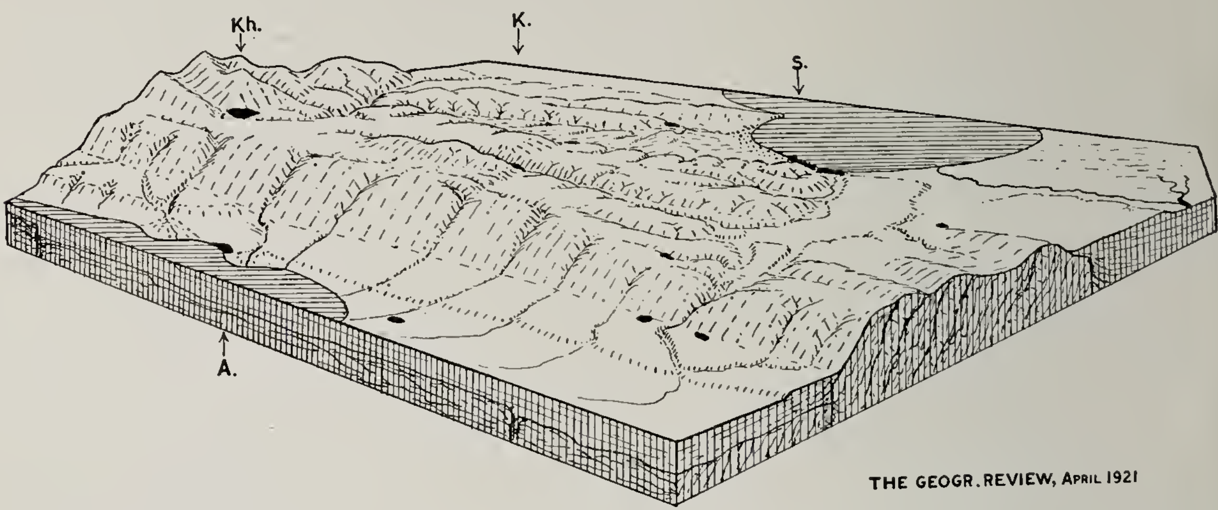

Fig. 6—Khortach Dagh near the western end. On the left is the summit of the ridge (1208 m.), Khortachkeui (Kh.) on its plateau, and Lake Langadhá with the fishing village of Aivasil (A.). Kirechkeui (K.) is in the valley behind the limestone monadnock (center). On the right is the gulf and city of Saloniki (S.) and the Dervend pass in the foreground, with the mouths of the Galiko on the extreme right. Nearly all villages are shown.

followed by the only highway across the range and probably also the course of the Roman Via Egnatia. The surface of the block for the first 30 kilometers of its length forms part of the lower and the higher peneplains; and in each case the hard limestone bands form the residual ridges, and the surface is deeply incised by ravines. The surface is mostly rocky and arid, and the villages dotted around the flanks are mainly concerned in cultivating the ground lower down. Kirechkeui, the "limestone village," with nearly 9,000 inhabitants, divides its attentions between the quarries above it and the cultivation of the slopes of the sheltered "strike" valley in which it lies. Khortachkeui lies on a patch of the high peneplain, flat as a table from edge to edge of the block and overlooked by the scarp of the forested ridge (1,208 meters) southeast of it. The inhabitants farm the residual clay of the plateau while from the forests above they furnish Saloniki with firewood and charcoal as well as chestnuts in the autumn, and, in the summer, with ice cut from artificial reservoirs on the mountain. Springs in the scarp also provide one of the main sources of water supply for Saloniki, and the plateau carries a magnificent aqueduct dating at least from Byzantine times.

Saloniki

The position at the head of a deep gulf of the Mediterranean coinciding with the entrance to the main north-south corridor through the Balkan Peninsula has always been occupied by a relatively large settlement, and the important prehistoric site lying to the southeast of the city bears witness to the earliest occupation. The nodality of the position was enhanced by

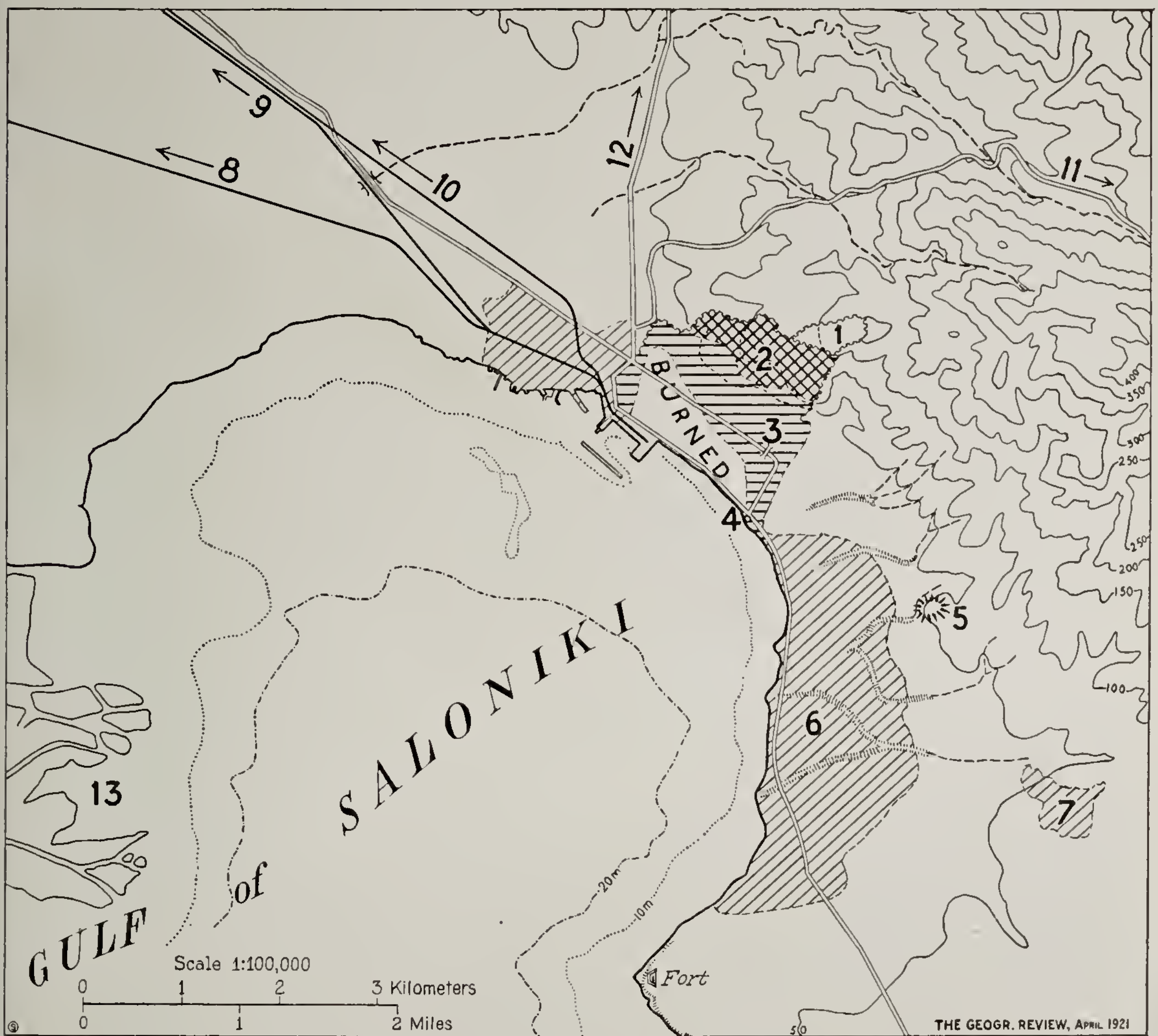

Fig. 7—Saloniki and environs. From a map by the French Service Topographique de l'Armée; 1, citadel; 2, Turkish town; 3, Arch of Galerius; 4, White Tower; 5, prehistoric settlement; 6, Kalamária; 7, Kapujilar; 8, Monastir and Athens railway; 9, Nish and Belgrade railway; 10, Constantinople railway; 11, road to Kirechkeui; 12, road to Seres (via the Derbend); 13, Vardar mouths. Contour interval 50 meters.

the construction of the Via Egnatia, which first touches the Aegean at this point. In the choice of the special site, the point of contact between the Khortach ridge and the sea, the aim must have been to control the traffic alongshore. The remains of the prehistoric settlement lie on the dissected shore terrace and are bounded by a ravine (map, Fig. 7). But a hill fort must have been built at an early date on the last spur of the Khortach block 200 meters above the sea, and the city must have grown downwards to meet a maritime settlement below. By the time the hill fort had been converted into the Crusaders' citadel (which now serves as a civil prison), and the

containing walls had been built down to the sea, the city must have had its present size excluding the Kalamária suburb; indeed it may have had this size even in classical times. This epoch has given to Saloniki the rectangular plan of the lower town with its main artery, the Egnatia Street, which is spanned at its eastern end by the triumphal arch erected about 300 A.D. in memory of Galerius, a general of Diocletian. This form is retained in the closely packed Jewish quarter. Whatever the original plan of the steep Turkish quarter below the citadel, it is now a typical medieval Turkish town with narrow irregular streets and stairs but with all the charm of the picturesque combination of overhanging houses, shady interiors, and quiet leafy courtyards and with delicate minarets always in the view. The devastating fire of August, 1917, left this part untouched but cleared the entire southern quarter and greatly reduced the accommodation of the city already overcrowded by its 170,000 inhabitants. The site of Saloniki, while fine from the point of view of medieval defense, is such that modern extensions have had to be northwestward for commercial needs along the radiating routes, and southeastward in the residential suburb of Kalamária. Beyond the suburb the land rises, and a bluff thrust forward towards the fingered delta of the Vardar is crowned by a modern guardian fort. Inland on the same rise lies the old Turkish village Kapíjilar, which signifies "the keepers of the gate."

The high part of Khortach Dagh has its smooth fault scarp on the northwest and its ledge of the higher peneplain broken only by narrow ravines; but in the southwestern face the smoothness is broken by two bastions standing forward—the bosses of igneous rock lying on the fault line. The few villages on the slopes of Khortach are mainly pastoral but with patches of cultivated land on the peneplain remnants. In general, however, the higher slopes are covered with deciduous bush or forest while lower down is the humble "pseudomacchia" of dark-leaved evergreen oak.

At the foot of this high block lies the low triangular plain of Vasilika, open to the gulf and narrowing eastwards (Fig. 8). This rich bottom land is all under permanent cultivation, and it supports Vasilika, a place of 1,500 inhabitants, and a line of smaller villages situated along the foot of the southern wall. If another reminder of the import of geological faults be needed here, it is found in the hot mineral baths at Sedes close to the remains of two large prehistoric settlements. East of Vasilika is a rocky threshold leading to the almost inclosed basin dominated by the town of Galátista with about 2,000 inhabitants. The basin is limited on three sides by high, straight, and very steep scarps clad with scrub. The bottom of this basin seems to form part of the higher lake terrace, while along it to north and south are fragments of the lower peneplain. All the gentle slopes are cultivated, at least intermittently. Galátista is built partly on the steep rocky slope and partly on a terrace of fresh-water limestone. The steep slope below is terraced, irrigated, and intensively cultivated, while the flat land of the basin is farmed without irrigation. The southern scarp of the basin has also a band

of terraced fields with many fruit trees, but these are owned and tended by the inhabitants of Vavdhos, a village situated some 200 meters above on the high plateau—another instance of the uneconomical mode of concentrated village life in Macedonia.

Western Khalkidhike also includes the high block of Vavdhos, almost a rectangle, with steep scarps facing the Galátista basin (west) the Resitnik basin (north) and tilted eastward to form a lower threshold joining it to the Kholomondos block. The western end of the latter carries the southeastward trend of the features down to the base of the Longos peninsula with a high steep scarp facing southwest in front of which lies Políyiros on the higher peneplain. The Vavdhos threshold is deeply trenched by the

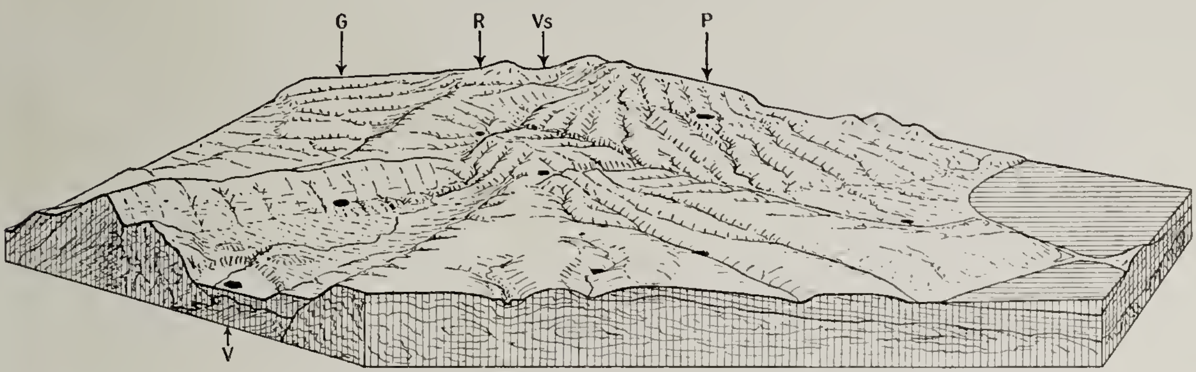

FIG. 8—Western Khalkidhike. On the left is the eastern end of Khortach Dagh with the Galátista (G) basin leading to the Vasilika (V) plain. In the center are the massifs of Kholomon Vuni (behind) with Políyiros (P), and of Vavdhos, with village of the same name (Vs). These are divided by a gorge leading from the basin of the Resitnik (R). Three igneous bosses are situated left of Vasilika, right of Vavdhos, and right of Políyiros. On the extreme right is the isthmus of Cassandra, the site of Potidaea. All important villages are shown.

incised meanders of the Resitnik Dere, which thus drains the oval basin of that name southwards by an impassable defile. This is probably an example of an antecedent river, and another case equally striking is found in the Miyalka, the principal river of eastern Khalkidhike cutting through a similar threshold by a similar defile north of the Longos peninsula (Fig. 9). The fault which limits these blocks on the southwest is marked by two further bosses of igneous rock each forming a group of hills, the one close up to the Vavdhos massif and the other near the northern shore of the Cassandra Gulf.

The whole of the remaining land consists in a block gently tilted southwards from the scarp overlooking the Vasilika-Galátista basins. This block consists in the north of crystalline rocks with a north-northwesterly strike, but over most of the area lies a thick mantle of weak sediments—clays for the most part, trenched by a series of valleys widely open near the sea and narrower near the crest. The coast is mostly low and arid, and there are three wave-built cusps, two of them near the western extremity, and the third forming the isthmus which links the finger of Cassandra to the mainland. Whatever may have been the original appearance of this sloping plateau of the southwest, it now looks like a rolling steppe; for, while it has

all been cultivated, there is always so much lying fallow that only the valley bottoms have the appearance of farm land.

The bulk of the Khalkidhike population is on this plateau, distributed in some 35 villages of which the smaller are occupied by Mussulmans, probably Yürüks from Anatolia, the larger population being Greek. There are also a number of *metochia*, or farms, belonging to the Athos monasteries and worked by the monks. The steep valley sides and the higher parts of the plateau are covered with evergreen-oak scrub. The Resitnik Dere widens near its mouth to a flood plain which extends eastwards along the Gulf. Here the natural vegetation is true *macchia* bush, but much of it has given place to fine groves of olive and mulberry, to vineyards, and other typically Mediterranean cultures. About the valley of the Resitnik the population is segregated in a small number of widely separated settlements: the high village of Vavdhos with its pastures and some intermittent cultivation about it and its lower farms in the Galátista basin; Resitnik in its upper basin, with access to Galátista through a pass between the Khortach and Vavdhos massifs; Políyiros, the old capital of Khalkidhike, central as to position but difficult of access; Ormilia at the head of the flood plain at the mouth of the Miyalka; and two villages on the flood plain of the Resitnik. Of these Políyiros is the biggest (c. 2,000). It was founded probably in classical times on account of ancient gold-mining attraction but now exists by agriculture both on its own plateau, where it has the highest olive groves in the region, and near the sea where it possesses a group of huts for the temporary residence of its farmers. Ormilia (Fig. 9) has its agricultural plain and a fishing station on the Gulf two and a half kilometers away, while its inhabitants also provide miners to work the chromite and magnesite which occur about the igneous boss aforementioned, the minerals being taken directly to sea.

At intervals along the shore of western Khalkidhike the mounds of prehistoric settlements are a feature of the landscape. The ancient Greek town of Potidaea was situated at the isthmus of Cassandra, and Olynthos and Mekyberna lay just east of the Resitnik Dere mouth. Their importance may perhaps be judged from the fact that Potidaea appears to have stretched from sea to sea, and Olynthos to have occupied nearly three square kilometers of area.

Eastern Khalkidhike

This hilly country is, humanly speaking, one of the most remote in Europe (Fig. 9); for, now that its gold which seems to have attracted the ancients to it no longer repays the working, its ways are little trodden by outsiders. It leads nowhere save to Athos, and it is much easier to reach that by sea. But its remoteness makes it worthy of study. Its build accounts for its inaccessibility. The crustal blocks which compose it are so oriented and tilted that there is a central basin; and, although the lowest wall of this is on the southeast, the coast there is a recent fault scarp, and the streams

drain inland almost from the precipitous coast itself. The drainage outlet from the central basin is the deep and winding antecedent defile cut by the Miyalka through upturned strata of hard limestone; and this is virtually impassable. The eastern crustal block consists of schists in the north and altered granite in the south; it is tilted towards the Gulf of Erissos, and its seaward slope is deeply dissected by streams, only one of which reaches the sea, the others burying themselves in the sands of the flat coastal plain. The block forming the Stratonikon Oros in the northeast has an abrupt straight scarp facing south and extending right out to Cape Eleftera and seems to be tilted northward to meet the extension of the Beshik block in an east-west fracture line. This area is extremely broken by erosion; but the

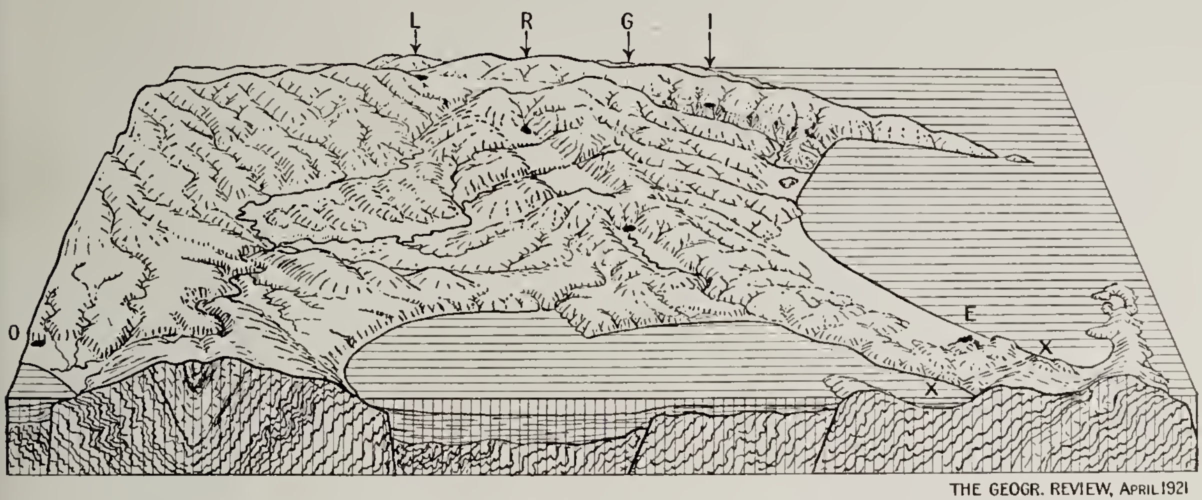

FIG. 9—Eastern Khalkidhike. In the background are the ridges of Kholomon (left) and Stratonikon (right) with the higher peneplain extending from Larígovo (L) to Izvoron (I). The central basin is drained by the Miyalka through its gorge to the plain of Ormilia (O). In front of a fault scarp are the isolated plateaus of Revenik (R) and Gomati (G). On the right is Erissos (E) and the beginning of the Athos peninsula with the remains of the Xerxes canal (X) on the isthmus.

line of contact is probably indicated by the through valley drained east and west, which is marked by a continuous strip of the lower peneplain surface.

The higher ridges of eastern Khalkidhike are covered with forests—probably primeval—of oak, beech, and chestnut, and the lower hills are clad in bush derived from similar forests which have been cut and which have been prevented from recovery by browsing goats. The valley bottoms are lined with fine groves of plane trees, and the coastal strips bear a luxuriant growth of *macchia* made up of numerous species of varied type. On the southern coast the Mediterranean pine forest (*Pinus halepensis*) has maintained itself in patches lending a pleasing contrast to the landscape. Land form and vegetation combine to make eastern Khalkidhike one of the beauty spots of Macedonia.

About the high ridges considerable tracts of the two peneplains remain intact, and it is on these that the main population is found. The strip of the higher surface which follows the southeastern slope of Kholomondos and that which faces the Gulf of Erissos are too deeply dissected to be inhabited; but to the east of the Kholomon range there lies a smooth

plateau surface with a heavy residual soil and an area of at least 20 square kilometers, not yet dissected by the erosion which is attacking the edges from three sides. This plateau is farmed or grazed—for there is much of it under grass—from three villages, the chief of which is Larígovo. An eastward extension of the plateau runs nearly to the sea but here is cut into patches, on one of which stands Izvoro close under the scarp and commanding a magnificent view of the pyramid of Athos in the southeast. It is a village of miners, and a light railway carries the ore—lead, antimony, and gold-bearing pyrites—to the gulf near by for export.

Under the fault scarp of the eastern block lie two patches of level land, portions of the two peneplains. The higher, which is dissected by narrow ravines leading to the central basin, is the domain of Revenik and is all farm land; the lower flat seems to be the upper part of an old wide valley, perhaps even a lake bed, of which the main part has disappeared with the subsided crust; while the stream by its violent erosion headward from the new gulf has all but broken upon the placid beauty of this little plain of Gomati, with its trim fields and sluggish plane-girt stream, and the village nestles in the farthest recess of the plain as if in fear of being undermined.

The central basin contains many hilly outcrops of the crystalline rocks, but its tributaries provide much flat land. The basin seems to be strikingly underpopulated, and for no apparent reason, for it is healthful, sheltered, and well watered. It is divided from the sea by a wide strip of bush-covered plateau, part of the lower peneplain, from which rises a higher wooded ridge.

The isthmus of Xerxes, which joins the Athos Peninsula to the mainland, rests upon the sunken end of the crystalline block northwest of it, and the rocks of this appear on the western coast; but the isthmus consists mostly of weak sediments dipping gently to the east. On a northern spur of a table of these stands Erissos, the successor of the classical Akanthos, and there is evidence that this strong strategic position has been occupied continuously since very early times. The coastal plain north of the village is fertile and moist, and in it all kinds of Mediterranean crops are raised; while the undulating land on the isthmus gives admirable pasture. Moreover, Erissos has its *skala*, or landing place, with many fishing boats. The remains of the canal cut by Xerxes 2,403 years ago to permit the passage of the Persian armada have been surveyed by Struck,[5] and the canal was found by him to have a length of some 2,450 meters, while its highest point is some 14 meters above the sea.

The Three Fingers

Of Cassandra, Longos, and Athos I have visited only the last. The others I have seen only from afar. But it seems clear that all three owe their remarkable shape to the subsidence of crustal blocks about them. Cassandra appears to consist mainly of weak sedimentary rocks, while Longos, like

[5] Adolf Struck: Makedonische Fahrten, I, Chalkidike, Vienna and Leipzig, 1907.

Athos, is almost entirely crystalline in character. Both are cut by many deep ravines and are crowned with Mediterranean pine forests, while the lower slopes have a *macchia* cover. In each there are considerable tracts of farm land, probably most in Cassandra. The villages and *metochia* are numerous and small, but it is doubtful if the population of Cassandra—which is Greek, like the most of Khalkidhike—is even now as great as it was in 1821, when 700 families with their flocks and herds are reported to have been massacred by the Turks after an insurrection. The natural vegetation of both peninsulas is very favorable to bee keeping, an occupation much practiced.

The Holy Mountain (Agion Oros) or peninsula of Athos presents one of the most striking landscapes in the Mediterranean. The long, narrow, rugged ridge, rising gradually towards its end and then springing suddenly at the tip to the pyramidal summit of white marble 1,935 meters above the sea, would be picturesque if it were all bare rock, but it is clad in a dense mantle of vegetation save for the high peak itself; luxuriant *macchia* bush and pine forests below, oak and chestnut higher up, and finally dark fir near the pyramid. Moreover, all along both sides twenty great monasteries and twelve subordinate houses occupy the most surprising and often most inaccessible sites, some of them perched on rugged spurs, others nestling in wooded chasms, but all of them beautiful in their varied medieval architecture. The great Russian monastery of Panteleimon with its white walls and green copper domes might be a piece of the Kremlin transported to a very different but still suitable setting; the Greek house of St. Paul at the western foot of Athos itself with the whiteness of its Byzantine walls vying with that of a huge fan of marble blocks which a recent earthquake detached from the pyramid above and hurled down the ravine to clog its mouth below the monastery—these are but two of the many astonishing glimpses to be had from the western gulf. On the eastern side, which as a rule is somewhat less abrupt, many of the monastic centers have had more room to spread their buildings in a picturesque irregularity; such places are Vatopédi, which is Greek, and the monastic village of Karies, the seat of the Holy Synod—the government of the monkish republic—while Khilandar, the Serbian house in the northeast, unlike most others lies out of sight of the sea in a secluded valley; but its defense was ensured by a high keep near the shore, whose summit is visible from the monastery.

The Vardar Basin

The lower Vardar valley which forms the western margin of the region is made up primarily of two lowlands separated by a higher block which is traversed by the Vardar in the antecedent Tsinganska Klisura, "Gipsy Defile."

I have had opportunity only for the most cursory observations in this section, and the following outstanding features of its geography have been

gleaned mainly from the writings of Cvijić, who has examined it in detail,[6] and from study of the new maps.

The high crustal blocks in the north overlook several lower blocks, nearly level plateaus, which are attributable to the various surfaces of erosion referred to throughout. They are composed in the west of granites and elsewhere of folded crystalline rocks, whose strike is northeast-southwest save in the high Dub ridge of Doiran, where it is north-northwest–south-southeast. The strength of the rocks here accounts for the isolation of the ridge. These plateaus have been attacked by erosion along lines of weakness, but the striking feature is still the extent of level surface broken only by narrow ravines. This smoothness is emphasized by the absence of any vegetation save the humblest oak scrub and the grass which becomes burnt up in the long summer drought.

The basin in the extreme northwest of the region appears to be due to crustal subsidence, like the Doiran depression, from which it is completely separated by the higher blocks; but the basin of Gevgeli, with which it is connected by the Vardar valley, is mainly due to normal erosion. The characteristic soil of all these plateaus and basins is generally sandy and coarse. In part it is residual and in part deposited, but it is always relatively infertile; and the large agricultural settlements are found near the Vardar with their fields on the alluvial fans brought from the well-watered mountains to the west or on the residual clays of the hill slopes. There is no lack of water for irrigation in the basin, and the large villages are surrounded by vineyards and mulberry groves, for it is one of the leading European centers of silk production.

West of the Vardar defile on patches of the peneplain, here trenched by deep ravines, where their inaccessibility renders them strong in defense, stand two of the largest Turkish villages in the region—each with over 2,000 inhabitants. Otherwise the plateau villages are small.

South of the Vardar defile lie the great flood plain, known as the Campagna of Saloniki, and the marshes of the delta. The plain has an even fault scarp for its western wall, but on the east it has two long extensions. The first of these runs to the northeast, is bounded by straight scarps of the crystalline rock on all sides, and all but reaches Lake Doiran. The low threshold separating the two basins has been cut through by the headward erosion of a Vardar tributary; with the result that the lake, which at a higher level was drained to the Struma, empties into the basin now under discussion, except in summer when there is no outflow. The bottom of the basin is occupied by Lake Arjan, by its marshes and peat beds, and by the deposits of a former greater lake which are now somewhat dissected by streams. The population lives either on the margins of this basin, where water emerges from the rocky rim, or else in small villages close to the streams. Elsewhere lack of permanent water precludes settlement, but the whole surface is cultivated intermittently.

[6] Jovan Cvijić: Grundlinien der Geographie und Geologie von Mazedonien und Altserbien, *Petermanns Mitt. Ergänzungsheft No. 162*, 1908.

South of this basin stands a wide plateau, about 100 square kilometers in area, of folded crystalline schist and limestone, ill-drained and thinly populated save at one fertile spot. The plateau is mostly given up to grazing. It overlooks in turn the second great arm of the Vardar plain, which leads southeastward through an area of alternating aridity and undrained swamp—the bottom of the former lake—to the Galiko valley. This section, like the last, has a very small population. But south of it stands an oval plateau of sedimentary strata round the margin of which is a ring of villages and a similar ring of prehistoric sites. The population probably lives by raising poor crops from an arid soil and by grazing flocks.

The Vardar has built an immense elongated fan beginning at the Gipsy Defile and reaching nearly 20 kilometers southwards. This accounts for the damming back of Lake Arjan. But the river has cut through its own fan and now runs in a very variable channel, frequently overflowing its banks. As a result the villagers on the east of the river valley do not practice intensive agriculture to any extent but are largely occupied with cattle keeping, for the pastures of the flood lands are rich. Moreover, in addition to the permanent settlements, a feature of the landscape is the temporary huts built of reeds from the swamps and occupied by the Vlach shepherds, who migrate hither from the hill pastures in the winter. Similar conditions regulate the life on the Vardar delta, where there are numerous villages and many temporary settlements amid the maze of reed beds.

The western rim of the Campagna presents an entirely different aspect. Here the villages are large and stand well above the plain on the terraces and well-watered alluvial fans. It is a zone of rich permanent agriculture with an important silk and wine production. The settlements of the Campagna thus fall into three classes: a western strip of important permanent agriculture by irrigation; a valley and delta strip with flooded pastures and cattle; and an eastern area with widely scattered villages practicing intermittent agriculture and tending flocks over a wide range of poor pasture.

Population Distribution

Figure 10 is a map showing the settlements of the region. The population statistics have been taken mainly from a source[7] which cannot be considered unbiased as regards race but is probably as good as can be found respecting the numbers. These statistics disregard the Mussulman population, which I have had to infer from various sources. My aim has been to show the population as distributed prior to the first Balkan war, in 1912, the wars which have involved the region almost continuously since that date having considerably upset the status and in particular caused a considerable evacuation of Turks from the region. In the Great War the population near the front was of course evacuated, and many villages were destroyed. In order to illustrate the meaning of this I have inserted the line which was the "front" in the region from 1916 to 1918.

[7] D. M. Brancoff: La Macédoine et sa population chrétienne, Paris, 1905.

In Macedonia people live entirely in villages, chiefly from motives of security in a troubled land. A map which shows every village therefore gives an accurate representation of the distribution of population.

I have added to the map the sites of known prehistoric settlements.[8] The remains of these are interpreted as the habitations of a people who lived to a large extent upon shellfish and were therefore dependent on the sea. They

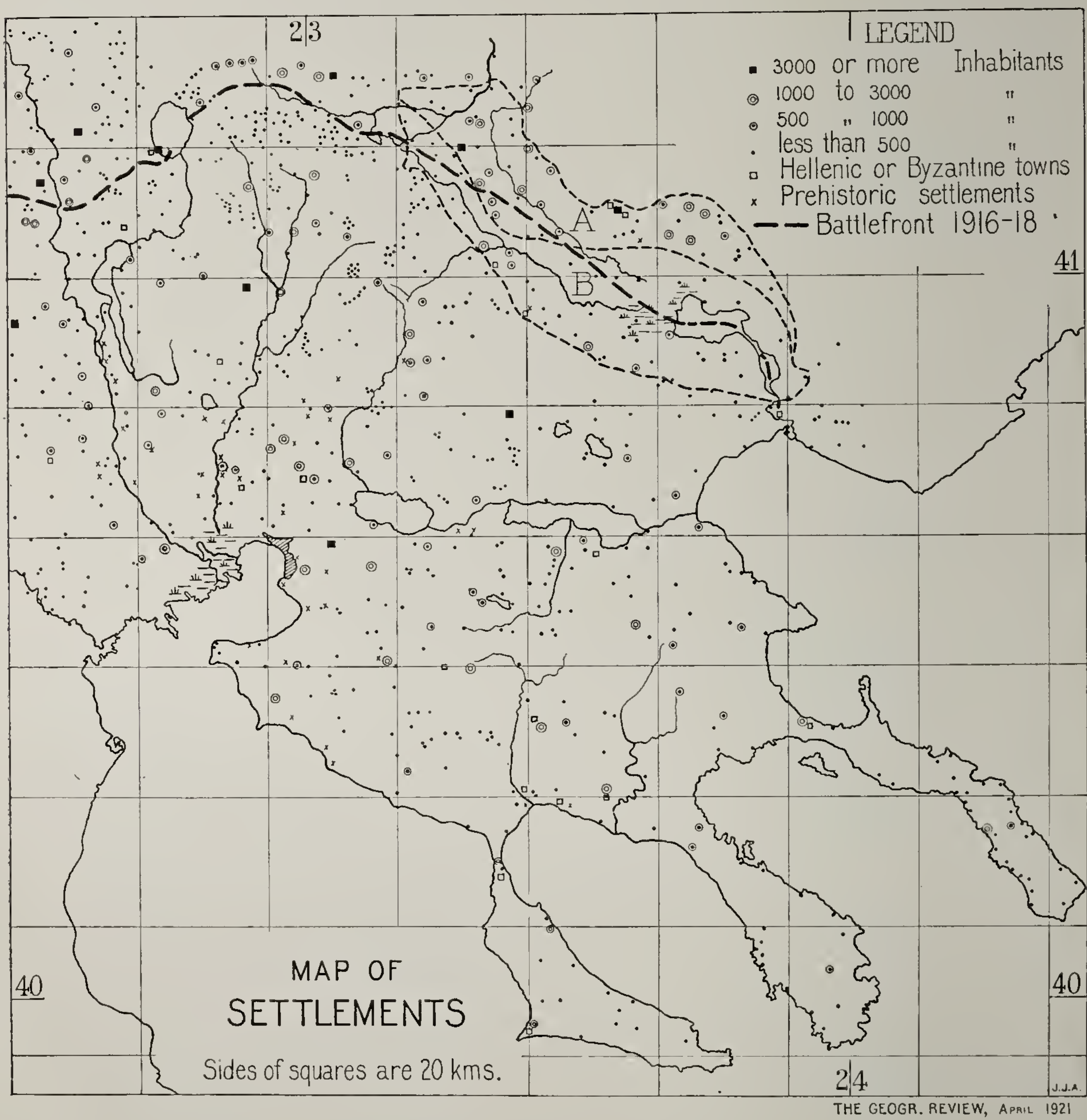

Fig. 10

would be further restricted to the coast lands by the forests which, as analysis of the vegetation shows, must have been much more extensive, at least in the eastern part of the region; and these peoples could not clear forests.

The chief classical and Byzantine towns which are known to history and archeology have also been shown. Their distribution is probably determined

[8] Taken from Adolf Struck: Makedonische Fahrten, I, Chalkidike, Vienna and Leipzig, 1907; *Bull. de Correspondance Hellénique*, Vol. 9, 1916, Paris; *The Annual of the British School at Athens, No. 23, Session 1918–1919*, London.

by considerations similar to those which have affected the modern population, but doubtless the dependence upon sea communication with Greece accounts for the predominance of large maritime settlements.

The most striking feature of present-day distribution is that the main mass of the people live or depend on the basins or the plateaus composed of sedimentary rocks. These are the areas where agriculture is simplest. The next is the surprisingly large population which exists by scratching the thin soil over every possible space on the high dissected plateaus.

The population will always remain overwhelmingly agricultural and pastoral; but, given a settled and progressive government, there must assuredly be certain definite changes in the population. The chief of these are as follows. The swamps and perhaps part of the lakes will be drained, additional rich farm land being thus afforded and malaria banished. Irrigation will be considerably extended, and dry-farming methods will be introduced in the more arid parts, while antiquated implements will be replaced by modern machinery. The hill populations will then have sufficient incentive to move down to the plains or to the lower plateaus, which with present methods are too arid to support many people. With scientific agriculture the Struma plain, for instance, would probably support nearly 500 people per square kilometer, instead of 217 as it does in its best section today. The hills will be reserved for pasture and forests; but of course these two interests must be kept quite separate, for the flocks and above all the goat must be kept out of the forest reservations if these are to succeed.

Appendix

In drawing the fracture lines shown on the map attention has been paid first to the geological boundaries, secondly to such information as exists regarding earthquakes in the region, thirdly to the distribution of hot and mineral springs, and lastly to the study of the topography. The information regarding the first three is contained mainly in the works of Neumayr, Bürgerstein, Philippson, Cvijić, Oestreich, Hoernes, and Nopcsa.[9]

[9] M. Neumayr: Geologische Untersuchungen über den nördlichen und östlichen Theil der Halbinsel Chalkidike, *Denkschriften Kaiserl. Akad. der Wiss. in Wien, Mathem.-Naturw. Classe*, Vol. 40, 1880, pp. 328-339.

Leo Bürgerstein: Geologische Untersuchungen im südwestlichen Theile der Halbinsel Chalkidike, *ibid.*, pp. 321–327.

Alfred Philippson: La tectonique de l'Égéide, *Ann. de Géogr.*, Vol. 7, 1898, pp. 112–141.

Jovan Cvijić: Die tektonischen Vorgänge in der Rhodopemasse, *Sitzungsber. Kaiserl. Akad. der Wiss. in Wien, Mathem.-Naturw. Classe*, Vol. 90, 1901, pp. 409–432.

Idem: Grundlinien der Geographie und Geologie von Mazedonien und Altserbien, *Petermanns Mitt. Ergänzungsheft No. 162*, 1908.

Idem: L'ancien lac égéen, *Ann. de Géogr.* Vol. 20, 1911, pp. 233–259.

Idem: Die Tektonik der Balkanhalbinsel, *Compte Rendu Congrès Géol. Internatl. IX*, Vienna, 1903, pp. 346–370.

Karl Oestreich: Beiträge zur Geomorphologie von Makedonien, *Abhandlungen K.K. Geogr. Gesell. in Wien*, Vol. 4, 1902, pp. 1–169.

Idem: Die Oberfläche Mazedoniens, *Geogr. Zeitschr.*, Vol. 16, 1910, pp. 560–572.

Rudolf Hoernes: Das Erdbeben von Saloniki am 5 Juli 1902 und der Zusammenhang der makedonischen Beben mit den tektonischen Vorgängen in der Rhodopemasse, *Mitt. der Erdbeben-Kommission der Kaiserl. Akad. der Wiss. in Wien*, No. 13 (N.S.), 1902.

F. Baron Nopcsa: Die Mineralquellen Makedoniens, *Mitt. K.K. Geogr. Gesell. in Wien*, Vol. 51, 1908 pp. 242–292.

As regards topographic evidence I have assumed that where a straight escarpment exists which cannot be explained as the ordinary boundary between weak and resistant rocks, a fault runs along somewhere near its foot. In most cases the slope is taken to be a fault scarp—the dissected fault face—and not the fault line scarp due to differential erosion of unequal rocks thrown together by faulting. In this respect there is strong similarity of appearance to the scarps of the Great Basin of the North American cordillera. In a few cases a fault is presumed to exist where one or more river valleys have a straight course not parallel to the rock strike, but these lines have only been drawn where there was different evidence for another section of the same line.

The fractures are marked on the map as continuous lines where there is evidence of one kind or another, and in some cases two such lines are joined by a broken line to indicate the supposed continuation. The probable direction of "throw" is indicated where possible by the usual spurs on the line, and it is noticeable that the throw along any fracture is now to one side, now to the other. In several cases two parallel faults have been drawn where only one may turn out to exist.

The fracture lines may be grouped as follows:

1. The "A" group, with an average northwest-southeast trend, i.e. parallel to the Dinaric folding.
2. The "B" group, with an average northeast-southwest trend, i.e. parallel to the pre-Dinaric folding.
3. The "C" group, of which the trend varies little from east-west.
4. The "D" group, of which the direction varies little from north-south.

Several curved faults are shown, and it is possible that other lines which meet at a small angle may prove to be curves. Following is a list of the fractures numbered as on the map. The evidence for the existence of each is stated thus: Geological, "geol.;" hot springs, "h.s.;" straight scarps, "sc.;" straight river valleys, "val.:"

"A" group, beginning in the west:

A 1, sc., and h.s. in N
A 2, sc. and geol. in N and S sections; val. in center
A 3, sc. and geol.
A 4, geol. and sc. in N; h.s. near Langadhá; sc. S of Ogurli; may be continuous with sc. on S coast
A 5, sc. and h.s. in N, possibly geol. at Deve Kran
A 6, sc. Truncates Olympus range at SW edge of region
A 7, sc. and geol. (igneous intrusion) and h.s., perhaps continuous to Ormilia (geol.)
A 8, sc. and geol. (intrusions)
A 9, sc.
A 10, continuous sc.
A 11, sc. at Langadhá perhaps continued to Revenik sc. and beyond
A 12, sc. and h.s.
A 13, sc. and h.s.
A 14, (in Beshik block) sc.
A 15, (in Beshik block) sc.
A 16, (in Beshik block) sc. and val.

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"B" group, beginning in the northwest:

B 1, B 2, B 3, B 4, and B 5, sc.

B 6, sc. and h.s.

B 7, sc. in SW; on Khortach and Krusha also val.

B 8, val. These two converge on Struma defile which is on one of the main N-S fractures of the Balkan Peninsula

B 9, geol. N of Saloniki; val. in Dervend and Láhana saddle

B 10, sc.

B 11, val. in SW; curving in NE sc. and h.s.

B 12, sc.; with step faults sc. and val.

B 13 and B 14, a small trough

B 15, sc.

B 16, sc. connecting with curve to S, sc.

B 17, B 18, B 19, B 20, and B 21, sc.

"C" group, beginning in the north:

C 1, C 2, and C 3, nearly continuous, sc.

C 4, four separate sections, sc.

C 5 and C 6, nearly continuous sc.

C 7, sc. in W, val. in E

C 8 and C 9, sc.

C 10, sc. and geol.

C 11, a curved fracture, sc.

C 12, sc.

"D" group, beginning in the west:

D 1, sc., perhaps a curve with A

D 2, sc. and val.

D 3, sc.

D 4, sc. at Mávrovo and Ogurli, probably connected with line of Resitnik Dere, val.

D 5, sc. at Mávrovo

D 6, sc. and val.; perhaps continuation determined situation of Miyalka defile

SOME HIGHWAYS OF ALBANIA AND A FORGOTTEN RIVIERA

By George P. Scriven
Brigadier General, U. S. A.

Of the minor events of the war whose effects have proved constructive rather than destructive one of the most striking is the opening up of certain difficult and little-known regions. In such regions as were the theater of operations there were established military bases and depots, seaports and centers of business, railroads and roads, many of which will remain as permanent aids to commerce and will open the way for more extensive intercourse in the future.

Of the more conspicuous works of this kind may be instanced the vitalization of southern Albania under Allied occupation. Valona from a forgotten hamlet grew into an important seaport and military base,[1] and from it were pushed out the splendid motor roads north, east, and south that now unite erstwhile isolated back country and seacoast.

The first roads built by the Italians in Albania were intended, of course, for army purposes; but even those were constructed, in the Italian fashion, to last through the years, and they will remain long after the soldier has gone his way. Others, less obviously military, were designed to open the land to its own inhabitants—to make intercourse practicable and perhaps later to invite the outlander and his trade. Of these new highways there are two that deserve especially the notice of the stranger interested in this fascinating land. They pass through scenes of rare beauty and attraction, among an interesting people, and by places which, though vividly historic and filled with an Old World charm, have been lost for centuries among their unapproachable hills.

The Highway from Valona to the Southern Frontier

The first of these roads is that running from Valona to the southern frontier via Tepeleni and Argyrokastro. Leaving the coast it first winds through great groves of olive trees for the planting of which the thrifty Venetians once paid the natives a liberal bounty, later recovered by a tax on the fruit. The policy proved successful, however, since the century-old groves are among the finest in existence, and the way through them is as pleasant as a drive through some great park as the road winds smoothly over the hills. Presently it begins to climb in a long zigzag course, steep to look at but with a grade never more than twelve per cent, the Italian

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[1] The ports of Valona and Santi Quaranta are illustrated in the article by H. Charles Woods: Albania and the Albanians, *Geogr. Rev.*, Vol. 5. 1918, pp. 257–273.

limit for motor roads in the Balkans. Soon the pass of Babica is reached, and beyond lies the shallow Sushitsa, behind which in the war days lay the second line of the Italian defense. In front a fertile valley extends to the slopes of the Maya Kulchit, a great mountain rising 6,000 feet above the Vyosa. The Vyosa, a rapid and treacherous river coming down from the Pindus Mountains, long marked the fighting line between the Italian and Austrian troops but is now a deserted stream without villages or culti-

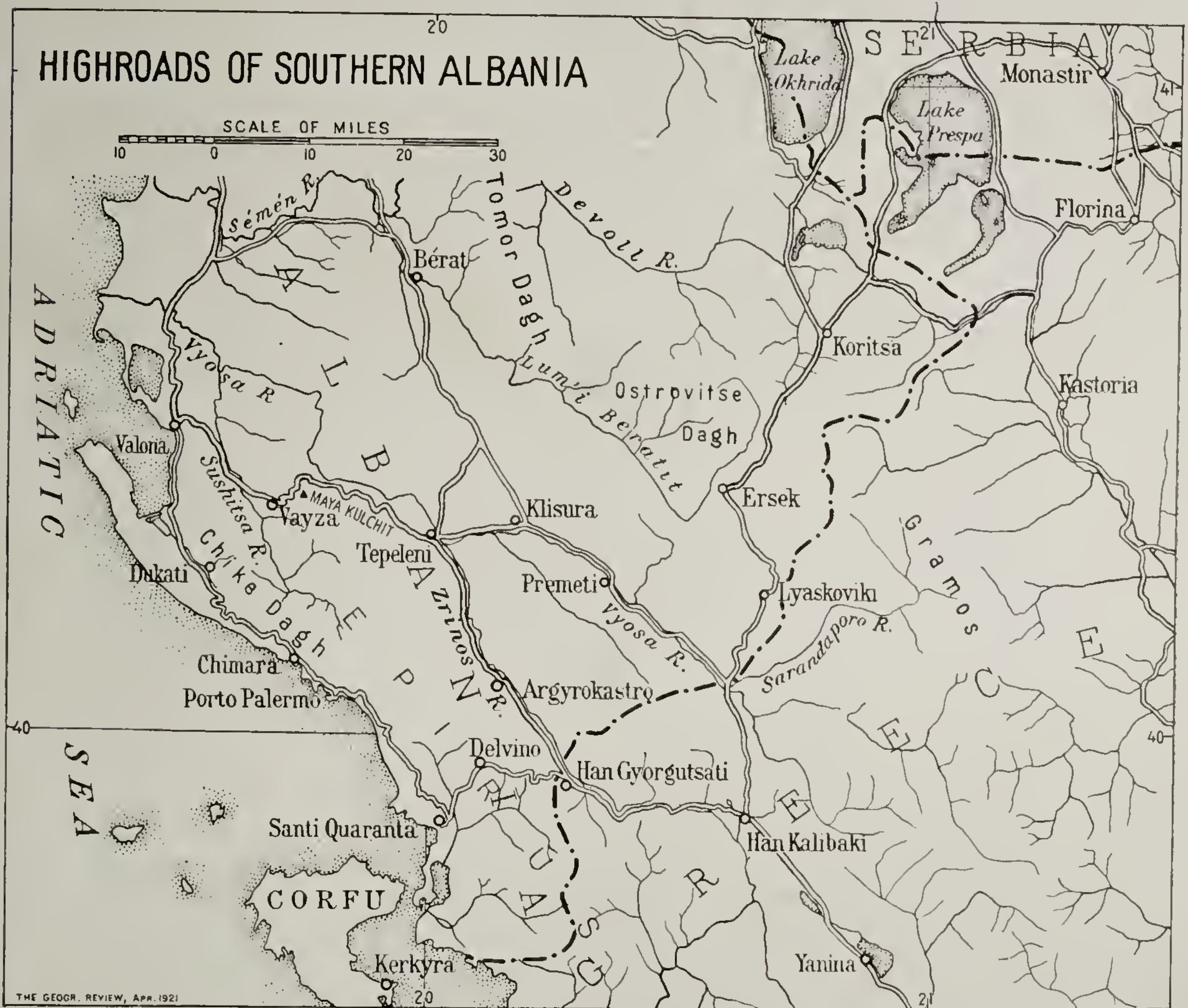

FIG. 1—Sketch map showing the highroads of Southern Albania. Scale approximately 1:1,700,000.

vation along its lower course. The road climbs the rugged Mt. Kulchit to pass into the Vyosa valley. A sharp turn into the pass of Vayza fairly takes away one's breath, while beyond the road winds over the mountain flanks like a wind-blown cobweb many hundred feet above the river bed.

On one side looms the overhanging mountain; on the other, far across the valley, a grand but desolate scene of mountain on mountain extends to the distant peaks about the pass called Chafa Glavs, a curious landmark among the chaos of hills. Between this and the Vayza a crag juts boldly from the valley in the form of a crouching panther, and on its crests stand the huts of a colony of the strange Rumeni (Vlachs), a people who trace their descent from the soldiers of the broken legions of Rome who dropped

FIG. 2

FIG. 3

FIG. 2—Turkish Tombs at Tepeleni. Tepeleni, which has its Roman and Venetian memories, became an important Turkish stronghold in the fifteenth century.

FIG. 3—Klisura on the Vyosa River. The Pass of Klisura, where the river has cut a deep gorge through the rugged hills, forms a gateway to Macedonia from the Adriatic.

Fig. 4

Fig. 5

Fig. 4—Kolonia, a village of the remote interior, is situated in a tributary valley of the Zrinos.

Fig. 5—Argyrokastro, a Moslem town of 6,000 inhabitants, stands on a rocky terrace overlooking the plain of the Zrinos. Note the square houses, with thick walls and small windows, a characteristic architectural type of Albania.

out along the Egnatian Way. Their descendants have remained as primitive in their lives as the shepherds of old, content to wander with their flocks over the mountain tops in summer and through the lower valleys with the approach of the winter storms. Their homes are often the caves of the hills, or rude stone huts on the mountain tops, without trees or shelter but secure against intrusion. They are an interesting but little-known people, these nomads, poor but proud of their descent, self-respecting and honest. Their settlements sometimes rise to the dignity of towns, and of these the most important in this region lies near the source of the Vyosa on the western slopes of the Pindus. I have written of them briefly in an earlier article.[2]

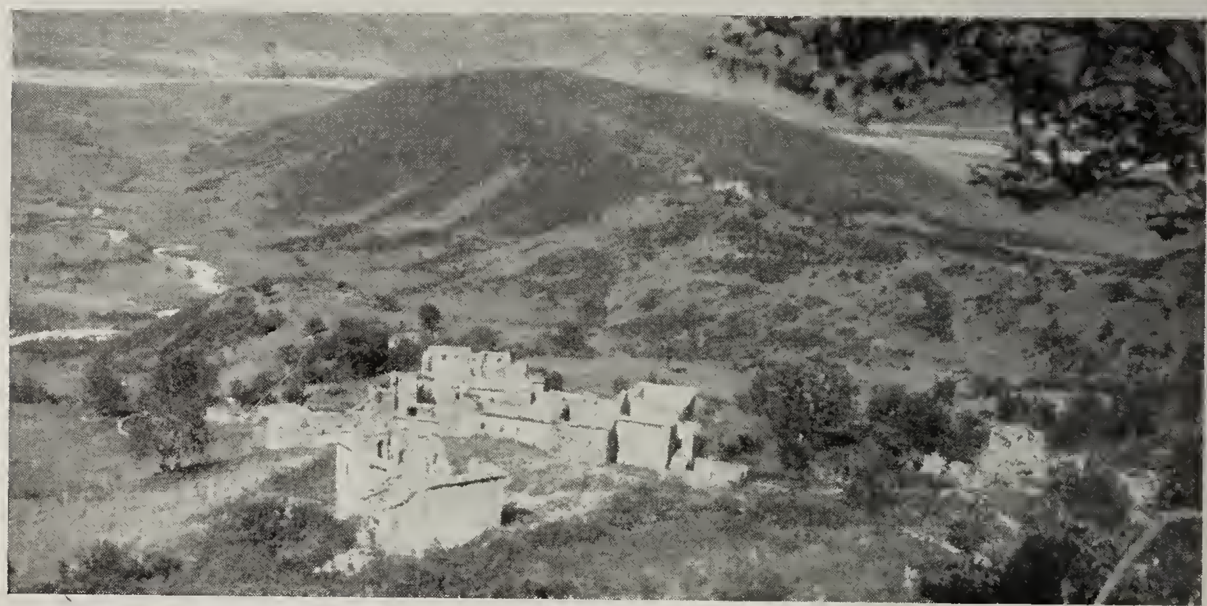

FIG. 6—A characteristic scene in the hills of southern Albania. The abandoned village of Dukay, with its ruined houses, marks the destruction of the Balkan Wars.

The way continues past the gray houses of Lopsi Martolozit, gloomy in appearance as are most Albanian villages except when seen in the sparkling sunlight of these glorious mountains. Beyond, the unroofed houses and abandoned dwellings of the village of Dukay mark the senseless destruction of the Balkan Wars and feuds. The road then drops into a little valley where the wild pear and other fruit trees grow and, crossing a river by the graceful arch of a Venetian bridge, arrives at the ruins of Tepeleni lying at the meeting place of three rivers in front of the pass of Klisura, the ancient gateway of Macedonia. Here the Romans once stopped the invasion of the eastern hordes; and fifteen hundred years later the Venetians came to enjoy the *villeggiatura* in peace and quiet. Now Tepeleni lies a complete ruin, a relic of the ruthless and cruel Balkan Wars of this last decade.

From Tepeleni, from which a new highway is being constructed through the Pass of Klisura, the route of the Zrinos (Drynos) follows an old Turkish

[2] G. P. Scriven: The Awakening of Albania, *Geogr. Rev.*, Vol. 8, 1919, pp. 73–83.

road through a valley well tilled and prosperous and passes the site of the so-called Fountain of Youth, a great spring that bubbles from the mountain side to form a pool and cascades, supplied no doubt by underground rivers fed by the snows above. The pool is framed by an amphitheater of gray hills which overlook the pleasant Zrinos valley. Beyond the fountain the highway crosses an occasional half-ruined bridge of Turkish or Venetian construction, which when slightly restored will still stand the strain of modern field guns, and presently reaches the turn to Argyrokastro, an Aladdin's dream town. Above tower the walls of a stately castle, a newcomer as structures go in Albania but old enough to have been reduced to a picturesque ruin; beneath lies the town, an irregular mass of huddled,

FIG. 7—A typical village site in southern Albania, Nivica Lopes in the hills west of Tepeleni.

gray-roofed buildings from which rise here and there the whitish walls of some church or mosque and the tombstones of a burial ground. On the whole it is a formless town whose narrow, roughly paved streets, without sidewalks, wind tortuously along the hillsides. In front of the open shops or bazaars with their meager wares mingle peasant and soldier, Greek pope and Moslem priest, with a sprinkling of children, pack horses, and donkeys —a scene of blended color, dirt, squalor, and charm, in which Europe has no part.

Beyond Argyrokastro the one level road of this region continues south through the valley shut in by ranges of limestone mountains—deserts of stone, rocky, treeless, and severe. The well-tilled fields lying along the river, though fertile, show little sign of life. As usual in Albania the isolated farms are unoccupied by houses, granary, or stables such as dot the holdings of other lands and add to the comfort and beauty of the countryside. In the morning the peasant comes down from his home in the hills with his buffalo or ox and primitive implements to cultivate the ground while daylight lasts, but when evening comes he returns to his eyrie in the mountains.

Near Han Gyorgutsati the level valley road joins the Turkish highway from Santi Quaranta, which long served as the entrance to southern Albania and the Epirus and indeed formed a connecting link between the Adriatic and Aegean Seas. The *han* is a stopping place for caravans and donkeys, memorable to the traveler, like others of its ilk, for its acute discomfort and vivid insect life. Here it marks an important parting of the ways; to the east the road turns across Albania and through Macedonia to far-away Saloniki; to the west it runs across the mountains of the Chimara to the Adriatic coast opposite Corfu.

The Eastern Branch to Saloniki

The eastern fork of the road, from Gyorgutsati to Saloniki is long and interesting. It passes through regions seldom seen and by places seldom visited which are older than the Christian era. The road was built by the Turk, doubtless following a long-traveled way, and for many years it served him in his control of the western Balkans. Of course it was not always so. Before the war it was scarcely passable, but with the coming of the soldier it was restored and became the main, indeed the only, line of communication to the west for the French and Italian armies of occupation lying west of the salient at Florina (south of Monastir). It may now be traveled from sea to sea as comfortably as any boulevard and must be considered as a masterpiece of road building.

From Han Gyorgutsati the road trends southeastward, crosses the Albanian frontier (as delimited by the London Conference of 1912) and enters Greece. At the relay station of Kalibaki, marked by a few huts, the road forks. A branch turns south to Yanina, an old stronghold of the Turk and now an orderly, violently Greek town. The main road turns north and re-enters Albania near the junction of the Vyosa with the Sarandaporo, crossing the latter by a high-arched Venetian bridge. Here the road branches again; northwestward the route was once well traveled from Yanina to Berat, but in the north it has long been neglected and at present is probably not traversible by wagon; however, it served the Allies during the war as a line of communication by pack.

The main road enters the mountains and ascends the steep grade to the ruins of Lyaskoviki, another victim of the eternal strife between Greek and Albanian. It then continues over forbidding heights to Ersek, where the right flank of the Italian army of Albania rested during the occupation, and thence to the city of Koritsa (Korcha) in the midst of vineyards and orchards, a wealthy and important place with trade in wool, skins, grain, and cheese. Copper deposits have been officially reported here. Passing south of the fine lake of Prespa the military road enters the confines of Macedonia, climbing high into the mountains, then dropping nearly 5,000 feet to Florina, whence the turnpike follows the route of the Via Egnatia over the mountains and into the Vardar valley. Skirting the capital of the

great Philip of Macedon, now marked by a few crumbling stones, it reaches the ancient city of Saloniki, once Thessalonica, on the shore of the Aegean Sea. A wonderful journey of some 400 miles is this trip across the Balkans, every mile of the road a delight to the eyes.

The Western Branch to the Adriatic

But to return to Gyorgutsati, from which the western branch of the highway leads to the Adriatic. Crossing the formidable hills of Chimara it descends to Delvino with its olive groves, a pleasant town of some commercial importance. Beyond, the road runs through a low, somewhat uninteresting region and, near the village of Metohi a short distance inland from Santi Quaranta, meets the end of the truly extraordinary highway recently constructed along the cliffs from Valona, 82 miles away. This is the greatest of the highways which may be counted among the remarkable achievements of the war.

The Corniche of a Forgotten Riviera

Always varied and picturesque this "Corniche of the Adriatic," as I venture to call it, is often truly magnificent as it passes over stream and mountain, now among the clouds and snow (heights bordering the coast attain elevations over 6,000 feet and are snow-covered during half the year), again at the level of the sea. Here it runs through a wooded defile, there along a precipice edge or jutting out upon a spur a thousand feet above the sea, which spreads like a turquoise veil to the gray-green hills of Corfu and to the dim shores of Italy beyond.

The grandeur and beauty of nature are not the only attractions of this Riviera; to them must be added the interest of history and the charm of romance. Through the Logara Pass the road enters the wild region of the Chimara, haunt of the brigand and of the vendetta. Here the traveler finds many traces of the past. At Vuno the Lion of St. Mark's grins rudely from the rocks; beyond lie uncovered the stones of a Roman road; and near by is the inlet where Caesar's triremes anchored to land his legions on their way to meet Pompey in the field of Pharsalia. Not far beyond, the little roadstead of Porto Palermo with its Roman memories and its Venetian fort and castle, even now mounting modern guns against attack, presents a strange blending of the wars of all ages.

Beautiful as it is, the coast of the Chimara is a lonely one; its mountain slopes lie unpeopled except for an occasional hamlet, like the quaint group of houses that form Chimara, or the hut of some fisherman farmer on the sandy shore of a cove running back into the mountains. It is strange, indeed, that so few people live in this land of promise where soil and climate produce the fruits of Sicily and where hillside and seashore offer as great a return to the thrifty peasant as they do to the tired sojourner of the towns.

Italy has opened to the world a forgotten Riviera more beautiful and interesting than the winter playground of the Mediterranean itself. That the coast of this Riviera lying almost in sight of Italy should have remained so long unknown may appear strange until one remembers the inhospitable nature of the country. The hostility of the natives of the rough, mountainous interior and the long neglect of the Turkish government have combined to render Albania the most inaccessible country of the Balkan Peninsula. Before the war no railroad existed in the country, and few traversible roads. A glimpse of the coast might be had from a passing ship, but little of the beauty or charm of the land could be discovered. Now all is changed. Once the narrow strait from Corfu is crossed, it is but an afternoon's jaunt by motor car from Santi Quaranta to Valona; and from Valona to Brindisi is a mere ferry boat trip of some sixty miles, while Rome itself is hardly more than a night's journey distant.

THE CAHOKIA INDIAN MOUNDS: A PLEA FOR THEIR PRESERVATION

By Thomas H. English
University of Wisconsin

The great works of the ancient inhabitants of the Mississippi valley are destroyed one by one. The bluff face near Alton, Ill., which bore the Piasa pictograph, was quarried away by lime burners in 1857; the "big mound" which stood on the present site of St. Louis was graded down in 1869. And now it seems that the ground occupied by the Cahokia mound group in the American Bottom is to be broken up into factory sites.

On his last visit to Cahokia the writer stood on the highest platform of the great mound and saw the smoking stacks of East St. Louis only half a mile away. The Cahokia group lies between East St. Louis, Ill., on the west and Collinsville on the east, between the Mississippi River and its bluffs, on an alluvial plain at this point eight miles wide. Both cities are enjoying great industrial prosperity and are rapidly growing together. Their junction may in a few years efface one of the greatest earthworks of prehistoric America.

Dimensions of the Cahokia Mound

There are in the Cahokia group no fewer than half a hundred mounds, many of them in a remarkably fine state of preservation. They are of different shapes and sizes—square, rectangular, round, and oval. In their present state of erosion they vary in height from four to one hundred feet. Brackenridge, who visited them in 1811, describes them as "resembling enormous haystacks scattered through a meadow."[1] Among the least eroded are the "Twin Mounds", one of which rises to a sugar-loaf peak while the other has a round top with a scalloped border like the large end of a conch shell.

In a central position dominating the group is the great tumulus known locally as the "Monks' Mound." It is rectangular in form. According to the survey by William McAdams (results published in 1883), the base dimensions are 998 feet from north to south by 721 feet from east to west. It covers an area therefore of about 16 acres. Later surveys have assigned respectively 1,080 and 1,010 feet as the length, and 710 feet as the width. The difficulty of determining the line of junction of the lower edge of the mound with the level of the plain is chiefly responsible for the variation. The mound is built in a series of four receding platforms, the highest of

[1] H. M. Brackenridge: Views of Louisiana, together with a Journal of a Voyage up the Missouri River in 1811, Pittsburgh, 1814, p. 187.

which is 100 feet (97 feet and 104 feet in the later surveys) above the ground level and whose arrangement and relative dimensions can be better understood from the illustration accompanying this article than from a table. The mound is *strictly* oriented with the longer side of the base in a right north-south line. The lowest terrace extends entirely across the southern face, and to the east of the center there is a projecting point which may originally have been a graded approach. The long north-south terrace on the west is badly gullied, and a modern road leading to the top of the mound cuts off one corner. In spite of years of erosion however, all outlines are surprisingly clear.

This type of truncated pyramida[1] structure was named by Squier and Davis, the pioneers in this field, the "temple mound."[2] Cahokia then would be mos nearly allied with the teocallis of Mexico, and it has been conjectured that on the highest platform of the Illinois mound burned the eternal fire to the sun god as on Tolula and Teotihuacan. Furthermore, Cahokia, because of its huge dimensions and the regular beauty of its construction, deserves comparison with the pyramids of Egypt as well as with those of Mexico. There was, however, no stone used in its building; it is merely a great heap of drift clay and sandy loam. Cahokia, El Sol at Teotihuacan, and Khufu at Gizeh are all straight with the points of the compass. Their base areas are respectively sixteen, thirteen, and thirteen acres, with base dimensions 998 by 721 feet, 761 feet square, and 756 feet square. Cahokia is 100 feet high, El Sol 216 feet, and Khufu 481 feet.

The great tumulus has never been explored. Mr. Thomas T. Ramey, who purchased the land fifty years ago and whose heirs still own it, took great pride in his possession of this impressive monument of antiquity, fenced it off from his cultivated fields, and carefully guarded it from the sacrilegious spades of relic hunters. His sons have likewise taken care that it should suffer from neither plow nor mattock. The "big mound" at St. Louis contained a large sepulchral chamber in its interior, but whether Cahokia has such a secret to reveal is yet unknown. That there was an extensive burying ground about it was discovered when Mr. Ramey, in ditching the field to the east, dug down through a deep stratum of human bones.

The Mound Builders

There has been much brave speculation concerning Cahokia and the race of men that reared its immense pile. The early antiquarians filled the site with all the barbaric splendor of an Aztec capital. Of these things little is known. Certainly the mound is of hoary antiquity. Its builders were with almost equal certainty Indians and not a distinct race, as was formerly held. The mound-builders, however, must have been semi-sedentary agriculturists, living in the villages and tilling the cornfields

[2] E. G. Squier and E. H. Davis: Ancient Monuments of the Mississippi Valley, *Smithsonian Contributions to Knowledge*, Vol. 1, New York, 1848, p. 174.

where their descendants were found by the French explorers. The Indians were often questioned by early settlers of the region about the origin of the mounds but seemed to have no information on the subject.

There must have been some extraordinary zeal dictating the erection of the great tumulus; for, if we accept its artificial origin, the greater part of the drift clay of which it is composed must have been carried in baskets from the bluffs, two miles away. Whether or not this was a temple erected in worship of the mighty Mississippi River near by, we cannot surely know. We have, however, the accounts of Garcilaso de la Vega,[3] the chronicler of

FIG. 1—Drawing illustrating the present appearance of the Cahokia Mound. Reproduced by permission from the article "Prehistoric Illinois" by J. F. Snyder, *Journ. Ill. State Hist. Soc.*, Vol. 2, 1909.

De Soto's expedition (1540–1541), of Du Pratz,[4] Bartram (1773–1777),[5] and others, in which temple and domiciliary mounds are described as having been in use by the Indians of the southern states. On these stood the council houses and the lodges of the *caciques*, and on these were the altars of the sun god's ever-burning fires.

Origin of the Mound

By some scientists it has been contended that the great mound of Cahokia is in large part a natural formation—a mass of loess, or drift clay, left by the receding glacial currents and shaped by the Indians to the present

[3] Garcilaso de la Vega: La Florida del Inca, Madrid, 1723.

[4] Lepage du Pratz: Histoire de la Louisiane, contenant la découverte de ce vaste pays, sa description géographique, un voyage dans les terres, l'histoire naturelle, 3 vols., Paris, 1758.

[5] William Bartram: Travels Through North and South Carolina, Georgia, East and West Florida, the Cherokee Country, the Extensive Territories of the Muscogulges, or Creek Confederacy, and the Country of the Chactaws, Philadelphia, 1791.

form.[6] It was the huge bulk of the mound, with the consideration of the long toil required for its erection, that first caused this theory to be advanced, for others of the same group have been proved to be artificial by the fact that they rest on a stratum of river drift. The contention cannot be resolved until a thorough exploration of the mound has been made by boring, trenching, and tunneling. Examinations of the soil of which it is composed have as yet shed no light on its origin. According to general authoritative opinion, it is highly improbable that such an outlier of the "bluff formation," or loess, would be left on an alluvial terrace.

At any rate there is no doubt that Cahokia was modeled with oriented sides by the mound-building Indians and was used by them as the central structure around which a great assemblage of similar though smaller structures were erected. It must be kept in mind, besides, that although Cahokia is treble the size of any other earthwork in the United States, its bigness is no good reason for rejecting the theory of its artificial origin. The magnitude of the works of primitive peoples has ever filled succeeding peoples with amazement.

The first account of the mounds was published by H. M. Brackenridge. He describes with enthusiasm two of the groups across the river from St. Louis, and of Cahokia he writes, "When I reached the foot of the principal mound, I was struck with a degree of astonishment not unlike that which is experienced in contemplating the Egyptian pyramids."[7]

He writes further, "The step, or apron has been used as a kitchen garden by the monks of La Trappe, settled near this, and the top is sowed with wheat."[8] This passage refers to a colony of Trappists who lived in the immediate vicinity of the great mound from 1810 to 1813, and in whose memory it bears locally the name of "Monks' Mound." The cabins in which they lived, however, were on the mound just east. The name "Cahokia" is applied to the group, and especially to the great tumulus, in memory of the Cahokia tribe of Indians, a member of the Illinois confederation, who may have been its builders and whose name is borne also by the creek flowing north of the group into the Mississippi.

The English geologist, Featherstonhaugh, described the mounds in his book "Excursions Through the Slave States."[9] In 1883 William McAdams

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[6] N. M. Fenneman (Geology and Mineral Resources of the St. Louis Quadrangle, *U. S. G. S. Bull. 438*, 1911) describes the mounds as mainly remnants of a former valley filling, the smaller ones of gentle slope and oval form being entirely natural. To the larger ones he assigns a composite origin. "To a height of 35 feet above its base the material of Monks' Mound shows assortment and stratification, which is evidently natural. Above that height it affords no structural evidence bearing on the question whether it is of natural or artificial origin; but the form plainly indicates the work of man, and not of geologic processes. It is highly probable that the mound in its natural condition was much lower and broader than at present, and was of rounded, almost drumloidal form, similar to the smaller ones of the group which now surround it." It should however be pointed out that a number of the smaller mounds have been opened revealing a fire-hardened altar or a decayed burial chamber at the center. The evidence of borings made has been variously interpreted, and the borings themselves do not appear to have been sufficiently deep or numerous to warrant a positive conclusion.

[7] Brackenridge, *op. cit.*, p. 187.

[8] *Ibid.*, p. 188.

[9] G. W. Featherstonhaugh: Excursions Through the Slave States, 2 vols., London, 1844; reference in Vol. 1, pp. 266–272.

of Alton, Ill., state geologist, published an elaborate account of the group,[10] with surveys, map, and figures. Since then the Cahokia mounds have figured in the transactions of many learned societies, and the archeologists of the world have urged their preservation.

A Plea for Preservation

A bill authorizing the purchase by the state of the most important part of the tract was introduced in the Illinois Legislature on March 12, 1913, but it came to nothing. A long campaign, waged by associations formed in St. Louis and in the towns of Madison County, Ill., the county in which the mounds are situated, was unable to extricate the proposal from the welter of politics. Discouraged by their failure to interest the state in the purchase, after many years of unavailing effort the owners are now treating with an East St. Louis realty firm, who may dispose of the land on which the mounds stand to the large manufacturing concerns which are already drawing close to them.

It is disheartening to think of what may then happen. There were originally four groups of mounds, on both sides of the river. The growth of St. Louis obliterated the very landmarks that had given her the name of the "Mound City." The town of East St. Louis, on the Illinois bank, destroyed a second assemblage. The mounds of the Long Lake group, twelve miles north, have been shoveled down to grade the roadbeds of several railroads passing that point. It is not yet too late to save the Cahokia mounds, but in a few years more it certainly will be. The Peabody Museum of Harvard University saved the Great Serpent, of Adams County, Ohio, when it was threatened with destruction. It is greatly to be hoped that some institution or association will come to the rescue in the present instance, before wanton destruction overtakes one of the great monuments of primitive man in North America.

[10] William McAdams: Antiquities of Cahokia, or Monks' Mound, in Madison County, Edwardsville, Ill., 1883.

THE NATURAL REGIONS OF MEXICO

By E. M. Sanders

Mexico claims the attention of the people of the United States more than any other foreign country, for it is at their door. In the southwestern states one can look over the border into Mexico without realizing that it is a foreign country. The international frontier follows no great physical barrier, and the same general sort of landscape continues across it without interruption. The wide grassy plains of Texas and New Mexico sweep southward into Mexico under new names but with many of the climatic and vegetal features familiar to us north of the Rio Grande. The plateau country farther west has its replica across the border.

Although little difference exists along the border, yet as one journeys southward the contrast with the United States increases. The relief is modeled on a much grander scale than in the border region. The country begins to assume a tropical facies. In fact Mexico becomes a very foreign land indeed. The progressive changes in this southward direction, as also the changes encountered from east to west, define several distinct regions which it is the purpose of this article to describe.

General Features

We may start with the conception of a great land mass, the core of which was formed of ancient rocks of great resistance, while on its surface there was deposited a thick series of strata of younger, softer rock. The latter became much crushed and folded, forming, besides many groups of isolated mountains, two great bordering ranges—a very imposing range along the western shore and one of lesser proportions that skirted the eastern edge of the land. The latter coast was bordered by a wide continental shelf, the former, by ocean depths. After erosion had worn down the entire surface to a state of moderate relief the mass was uplifted many thousands of feet, a part of the continental shelf being thus transformed into coastal plain, now wide, now narrow, and an immense plateau being created, bounded on three sides by enormous escarpments. The rejuvenated streams have already incised deep valleys in the edges of the plateau, and are pushing back the heads of their valleys vigorously into the interior, although as yet dissection is in an early stage. Associated with the earth movements, volcanic forces have built up a multitude of symmetrical cones upon the plateau surface, their eruptive materials burying whole sections of the former relief, particularly along the western and southern rims of the highlands.[1]

[1] Bosquedo Geológico de México, *Inst. Geol. de México Bol. No. 4, 5, 6*, 1896. The physiographic provinces worked out from this geological survey correspond very closely with those given in "The Physiography of Mexico," by W. N. Thayer, *Journ. of Geol.*, Vol. 24, 1916, pp. 61–94.

Northern Mexico is bordered on the east by a coastal plain stretching far inland, behind which rises a step-like escarpment leading up to the plateaus and high plains of the interior. The plateau land continues throughout the center of Mexico, merging westward into the rough mountainous land of the Western Cordillera. An exceedingly steep escarpment borders this cordillera on the west, dropping down to a wide stretch of desert in the extreme north and to a narrow coastal plain farther south.

As one journeys southward there is a gradual change since the movement of uplift was greater in the southern part and at the same time the continental shelf was narrower there. The change is first noticeable on the eastern side. Here the breadth of the coastal plain diminishes, and the height of the plateau that forms the interior increases, with the result that the eastern escarpment becomes formidable. The farther south one goes the more accentuated becomes this feature until the nineteenth parallel is passed. In addition to the increase in height the plateau tapers towards the south, becoming narrower and narrower until at the isthmus of Tehuantepec it comes to an abrupt end.

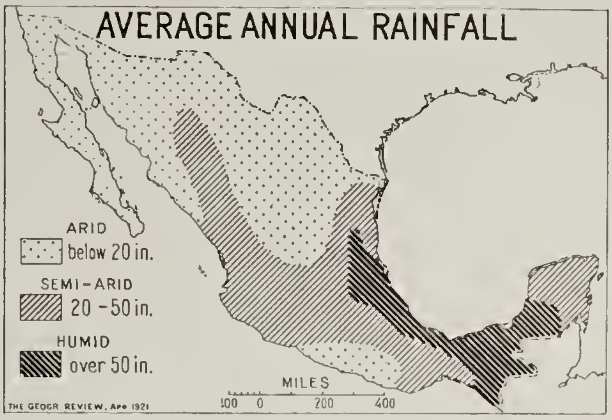

FIG. 1—Diagrammatic map of mean annual rainfall of Mexico. For a more detailed map see Fig. 10 on p. 255.

Both the great plateau of the interior and the coastal plains are a distinct continuation of North America, but to the south of the isthmus the structure of the country is allied to that of Central America. This southern portion consists of another plateau (insignificant in size and importance in comparison with the great plateau north of the isthmus), bordered by an extensive coastal plain on the side facing the Gulf of Mexico. This coastal plain continues northeastward forming a part of the peninsula of Yucatan.

Climatic Regions

A study of the development of human activities and of land forms in Mexico emphasizes rainfall as the all-important factor. Basing the classification on the annual rainfall, the climatic regions of Mexico can be divided into three groups: (1) Arid, (2) Semi-arid, (3) Humid. The extent of these regions is shown on the map (Fig. 1). The area classed as arid has drought during the greater part of the year, the average annual rainfall being less than 20 inches. The semi-arid areas have a rainy season of about the same length as the dry season, with an annual rainfall of less than 50 inches but greater than 20 inches. The humid areas have rain during more than half the year and an annual rainfall of over 50 inches.

Each of these main divisions comprises many varieties due to difference

in situation with regard to the rain-bearing winds and to differences of altitude. The rain-bearing winds for the most part come from the east, and thus the eastern part of each division is rainier than the western part. For example Sonora is very largely desert, while Chihuahua has enough rain to allow considerable agricultural development.

To an even greater degree does altitude contribute to variation in climate. Corresponding to the coastal plain, escarpment, plateau, and lofty mountain ranges are four clearly defined climatic zones. This altitudinal zoning has played such an important rôle in the development of the country that, well known as it is, it deserves emphasis. As one passes inland the first zone is

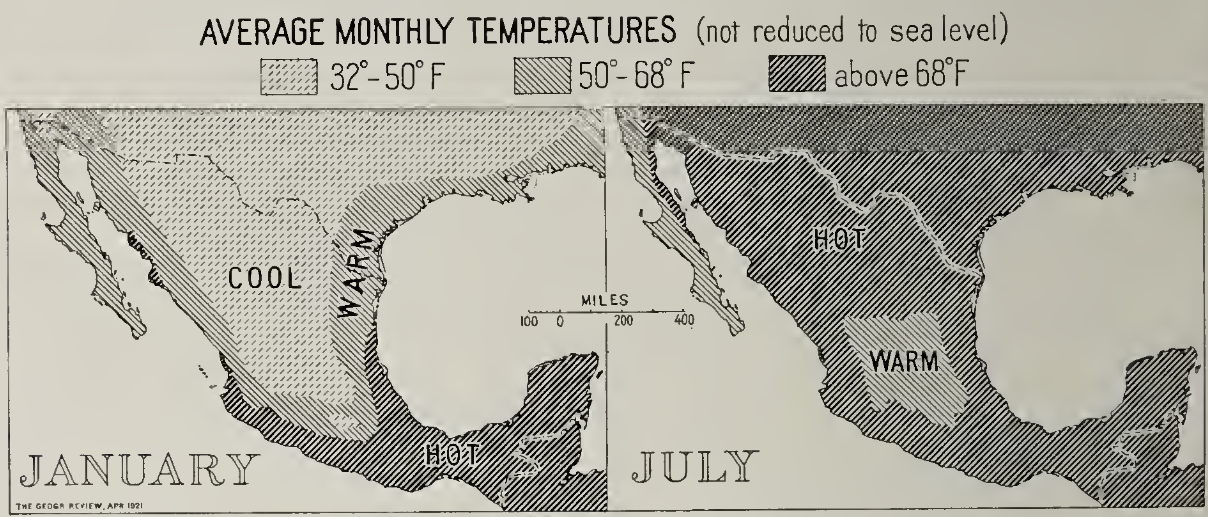

Fig. 2—Diagrammatic maps of mean monthly temperatures in Mexico in January and July. For a map of mean annual temperature see Fig. 9 on p. 254.

tierra caliente, the hot country; next the zone of the escarpment, *tierra templada*, the warm lands; then that of the plateau, *tierra fria*, the cool zone; and lastly the zone of the high mountains, sometimes called *tierras heladas*, the frozen heights. On the accompanying maps are shown the actual average temperatures in January and July, not reduced to sea level. The graphs in Figure 3 epitomize the whole.[2]

Coastal Regions

The coastal plain bordering the Gulf of Mexico presents four distinct types of relief. First is the Tamaulipas strip stretching from the Rio Grande to a short distance south of Tuxpan. Physiographically it is a continuation of southeastern Texas,[3] an almost featureless plain, margined by wave-built reefs, and running inland for many miles. As it approaches the mountains it becomes more uneven, gradually merging into the foothills of the escarpment.

[2] The classification, etc., is based upon (1) data supplied in manuscript by the U. S. Weather Bureau, Washington, D. C., 1919, (2) Julius Hann: Handbuch der Klimatologie, Stuttgart, 1910, Vol. 2, pp. 318–330.

[3] W J McGee: The Lafayette Formation, *12th Ann. Rept. U. S. Geol. Survey*, 1890–91, Part I, pp. 353–521; reference on p. 376.

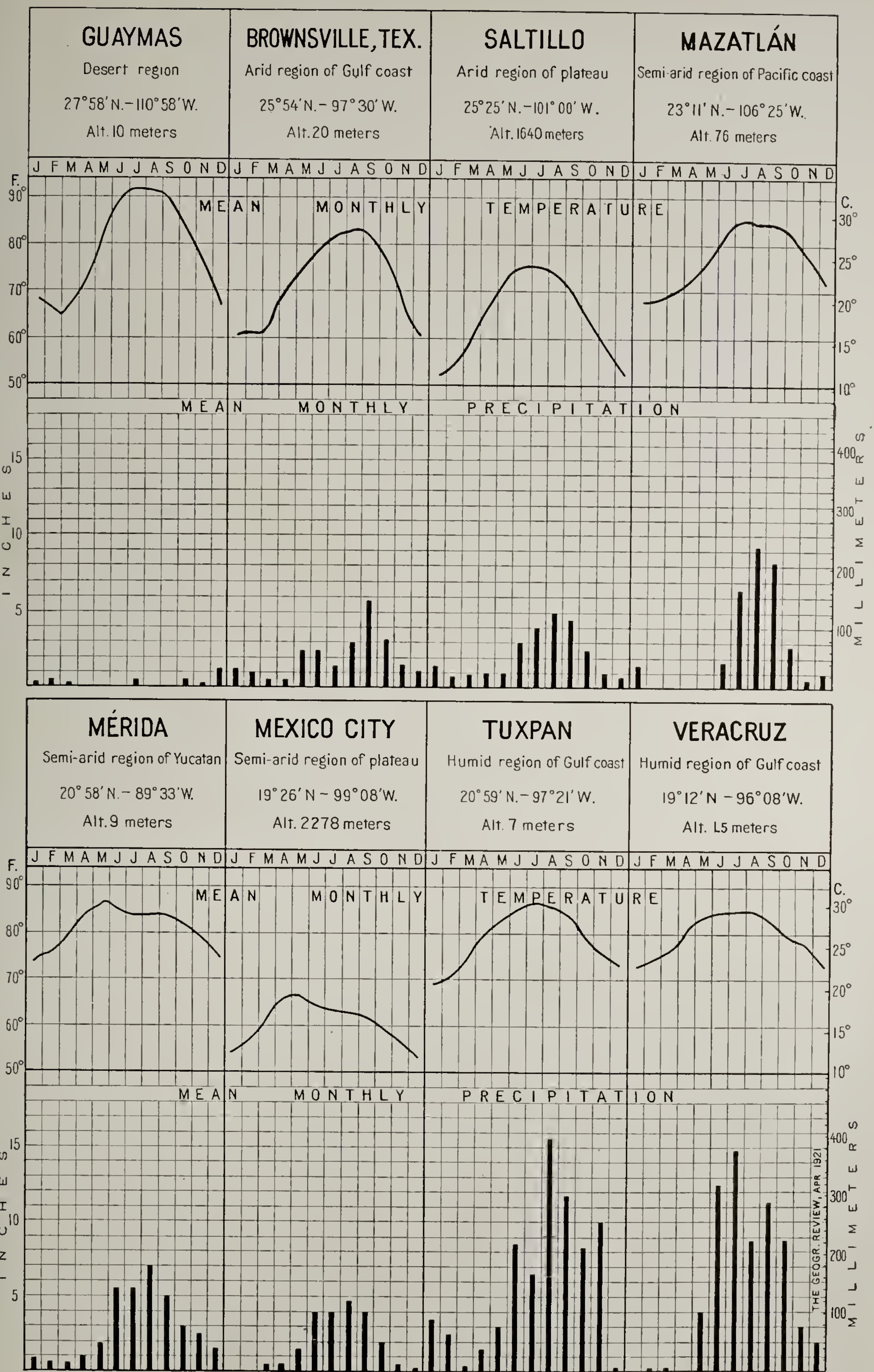

FIG. 3—Temperature and rainfall graphs.

FIG. 4—National regions of Mexico. Scale 1:17,500,000. The diagrammatic fracture lines are after Felix and Lenk, work cited in footnote 17.

The vegetation is sparse on account of the aridity of the climate. Behind the dunes and swamps of the littoral the ground is covered with chaparral, in which dense growth of brush mesquite is typical. Toward the south the climate becomes more favorable to vegetation, and islands of tropical trees appear among the mesquite brush. Clumps of fig trees and palmettos break the monotony of the landscape, and the mesquite itself is modified, becoming a tree some 20 feet in height. Near the coast the chaparral alternates with wide savanas.[4]

The Veracruz strip differs in several respects from the section just described. The width of the plain diminishes, almost disappearing in the southern part. The lagoons are smaller and in places disappear altogether. The altitude of the bordering escarpment is greatly increased. Rainfall is heavier and gives rise to many permanent streams, and thus the coast line is broken by many river mouths. The southern part of the plain is much broken by the spurs of the dissected edge of the plateau and the relief is still further complicated by volcanic action. Great cones are perched near the edge of the escarpment, while the volcano of Tuxtla rises in the midst of the plain itself.

The natural vegetation of this division is dense jungle, formed partly by thickly packed mesquite brush and partly by plants of the tropical forest. Here and there are natural clearings, however, open savanas which form rich pasture land. In the southern part of the plain are two well-marked zones of vegetation: the valleys are filled with thick jungle, while the crests of the encroaching spurs are clothed with coarse grass broken by clumps of trees. Large stretches of land have been cleared, and plantations established. Coffee is grown successfully on the upper slopes of the ridges, tropical fruits on the lower slopes, and on the plain itself crops such as sugar cane thrive.

The third, or Tabasco division, is in many ways like the Tamaulipas strip. It also borders a shallow sea and has so slight a slope that the streams have next to no current. They end in swamps, and wind and waves build up sandy spits and islands, eventually forming lagoons. The conditions for ports are even worse than in Tamaulipas, for the shelterless coast is exposed to the full fury of the storms that sweep from the north. Behind the shore line a coastal plain covered with dense vegetation stretches far inland. Rolling country succeeds it, beginning about 50 miles inland and continuing in a broad strip parallel to the coast.

The vegetation ranges from the same sort of jungle that covers the Veracruz strip to the dense tropical forests of southern Mexico. An impenetrable wall of shrubs and creepers guards the dark, damp interior, which is roofed in by the tops of lofty trees whose branches are matted together by creeping plants. In places along the rivers stretch wide savanas.

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[4] Vegetation largely based on J. W. Harshberger: Phytogeographic Survey of North America (Series: Die Vegetation der Erde, Vol. 13), New York, 1911, pp. 633–672. See also Isaac Ochoterena: Las regiones geográfico-botánicas de México, *Bol. Soc. Mexicana de Geogr. y Estadística*, Vol. 8, 1919, pp. 221–231.

Fig. 5—Vegetation map of Mexico. Scale 1:17,500,000.

The Peninsula of Yucatan

The fourth division,[5] where the Gulf Plain attains its maximum width, is the peninsula of Yucatan. Structurally this section is quite distinct, the peninsula being built up of almost horizontal layers of an extremely soluble limestone. A karst topography is the result, there being no surface streams but an extensive subterranean system and a characteristic development of sink holes, known locally as *cenotes*.[6] With the exception of a single range of hills in the western part, the whole peninsula is flat or very gently rolling, much cut up by shallow hollows separated by low ridges averaging six to ten feet in height. The northern and western coasts are low and flat, except for about 30 miles south of Campeche, where low hills, which run across the peninsula, reach the shore line and define a rocky coast fringed by coral reefs. Coral reefs also form a barrier along the entire length of the eastern coast. The northern coast is bordered by an almost continuous sand bank enclosing an extensive brackish lagoon.

The northern coastal strip is dry and covered by dense chaparral. The low compact shrubby growth is broken here and there by stretches of grassland. Strange to say, this unprepossessing district has become one of the richest agricultural regions of Mexico, the soil and climate providing ideal conditions for the production of sisal fiber (henequén). Furthermore the aridity makes it possible to clear the land by burning the brush. Formerly the work of extracting the fiber was so arduous as to make production on a large scale impossible, but lately the invention of a machine to do this work, and an increased demand for the product, have caused the industry to progress by leaps and bounds and have made this arid district one of the most prosperous in the country.[7]

The Pacific Coastal Regions

The Pacific seaboard of Mexico is not important either as regards size or production. In general the strip of lowland between the high mountains and the sea is narrow, while nearly the whole of it suffers from aridity, desert alternating with semidesert as one journeys from north to south.

The northern desert part comprises both the peninsula of Lower California and the state of Sonora. The peninsula is a partially submerged mountain range, the Gulf of California, which separates it from the mainland, being a great flooded valley. The latest earth movement has re-elevated a narrow coastal plain on both sides of the peninsula. The eastern shore of the Gulf of California is formed by the coastal plain of the states of Sonora and Sinaloa which in places attains a width of 70 miles. It is bordered by sand dunes, and both coast and hinterland are desert.

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[5] Karl Sapper: Sobre la geografía física y la geología de la peninsula de Yucatán, *Inst. Geol. de México Bol. No. 3*, 1896.

[6] L. J. Cole: The Caverns and People of Northern Yucatan, *Bull. Amer. Geogr. Soc.*, Vol. 42, 1910, pp. 321–336.

[7] Ellsworth Huntington: The Peninsula of Yucatan, *Bull. Amer. Geogr. Soc.*, Vol. 44, 1912, pp. 801–822.

South of Sonora the coastal plain is very narrow, in places disappearing altogether, and it is cut off from the interior by the almost impassable mountains of the Western Cordillera system.[8] Beyond Cape Corrientes the coastal plain broadens somewhat and is bordered in places at its seaward edge, by lagoons and sand hills which form a marked contrast to the lofty cliffs succeeding it and continuing southward until the coastal strip of Chiapas is reached. This latter is the only part of the Pacific coast which does not suffer from aridity.

The Escarpments

The escarpments are the edges of the uplifted plateau which forms the interior. An examination of a contour map of Mexico shows that three main types are embraced herein: the step-like escarpment of the northeast, the ragged escarpment of the southern and southeastern edge of the plateau, and the cliff-like escarpment of the Western Cordillera. The first type extends from the border to about the latitude of Tampico. Its low and step-like character is most apparent in the northernmost part. Here the plateau is less than 2,000 feet high at a distance of 200 miles inland. Erosion of the horizontally disposed newer rock that covers the hard core causes the ground to rise in easy steps as one journeys inland from the sea. The gradient is rendered still less steep by numerous alluvial fans washed down by the short-lived streams of the rainy season. Farther south, however, the climate becomes less arid, permanent streams are frequent, and the plateau edge is cut up into a ragged fringe of spurs. The plateau also rises in height, attaining over 5,000 feet inland from Tampico, and at the same time it approaches nearer the coast, the escarpment being only about 100 miles inland. Thus the difficulty of crossing the northeastern escarpment gradually increases as one goes toward the south, and the step-like escarpment of the north grades into the ragged escarpment of Veracruz. The altitude of this escarpment is much greater than that of the step-like escarpment; the plateau surface averages 7,500 feet in height while from its edge rise lofty volcanic peaks, for example, Orizaba, over 18,500 feet in height.[9]

A change of climate still further accentuates the difference between the ragged and the step-like escarpments. The climate of the Veracruz region is by far the more humid, and in consequence the course of erosion is very different. Instead of the edge of the escarpment being blunted by alluvial fans it is rendered still more difficult for transportation by dissection. The ravines, called *cañadas*, are often more than 2,000 feet in depth. Vulcanism in the form of cones and lava flows still further complicates the relief.

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[8] Carl Lumholtz: The Sonora Desert, *Geogr. Journ.*, Vol. 40, 1912, pp. 503–510.

W J McGee, in his work on the Seri Indians (*17th Ann. Rept. Bur. Amer. Ethnol.*, 1895–96, Part I, pp. 9–50) gives a description of the physical character of this region. See also, by the same author, the article "Papagueria." *Natl. Geogr. Mag.*, Vol. 9, 1898, pp. 345–371, and W J McGee and W. D. Johnson: Seriland, *Natl. Geogr. Mag.*, Vol. 7, 1896, pp. 125–133.

[9] *Geogr. Journ.*, Vol. 51, 1918, pp. 190–191.

The vegetation of these two escarpments is as distinctive as the relief. The northern part of the step-like escarpment is unproductive, being covered with mesquite and poor grass. As one goes south the increasing humidity causes the grass to improve in quality, and it provides rich grazing land. Farther south still the ragged escarpment of Veracruz forms one of the richest agricultural regions of the country. The natural vegetation is deciduous woodland, principally oak and pine, with grass on the upper slopes, while semitropical forests occupy the lower slopes. The pine forests, which supply timber to the treeless plateaus of the interior, are dense at an altitude of 6,000 feet and at a height of 8,000 feet dominate other vegetation. From 4,000 to 6,000 feet altitude there runs a belt of mixed pine and oak. Where the land is cleared plantations of coffee, tobacco, sugar cane, and tropical fruits thrive at the lower altitudes, and on the higher ground the grains of temperate lands can be grown.

The Western Escarpment

The western escarpment forms a striking contrast to the fertile escarpment of Veracruz. It consists of the barren, ravine-scored flank of the Western Cordillera, which cuts off the coastal regions from the interior. In the northern part the Sonoran slope is less steep, but the land is desert and forms as great a barrier as do the mountains in the more southern section. Owing to the aridity of the climate large stretches of the western escarpment are almost without vegetation, and considerable areas are covered with desert plants and shrubs which are of no economic value. Where the rainfall is sufficient, however, extensive forests cover the lower slopes, producing valuable woods such as mahogany and logwood. Above 4,500 feet this vegetation gives place to oak forests, which flourish up to 8,000 feet, beyond which conifers dominate. The lower slopes are used for growing corn, sugar cane, tobacco, cotton, and fruit in regions where enough rain falls or where irrigation is possible.[10]

The Highland

If classified according to general structure, the highland region falls into two parts: the northern portion, comprising the greater part of the country and terminating at the isthmus of Tehuantepec; and the minor southern part, comprising the mountains of Chiapas.

The northern part of the Highland is divided into four natural regions, the upland desert of Lower California and Sonora, the Western Cordillera, called the Sierra Madre Occidental, the dry northeastern plateau, and the great Central Plateau (Mesa Central).

The Desert of Sonora and Lower California

Lower California is a narrow strip of mountainous land with a general northwest-southeast trend, parallel to the chief mountain ranges of the

[10] H. M. Wilson: Topography of Mexico, *Bull. Amer. Geogr. Soc.*, Vol. 29, 1897, pp. 249–260.

Pacific coast. It consists of a core of ancient rock which had been carved into a state of high relief by erosion before it was depressed and buried under newer strata of great thickness. It was again uplifted and a large part of the newer deposits eroded. Thus its relief is of two types, ancient sharp-peaked mountains, disclosed where the newer strata have been removed, and mesas often capped with lava formed by the dissection of the newer strata.

In the extreme south there is sufficient rain to allow permanent streams, and the granite mountains are carved into deep valleys. In the northern part, where the relief culminates in the San Pedro Mártir Sierra, there are also permanent streams. As a rule, however, the aridity is broken only by rains of short duration and torrential character, and dry deep water-courses with great alluvial fans are the result. The natural vegetation as a whole is distinguished by its extraordinary desert flora, chiefly of thorny growths, of cactus, agaves, and yuccas including many peculiar species.[11]

The upland desert of Sonora takes in the northern part of the land on the eastern side of the Gulf of California. It is an interesting example of erosion in an arid climate. The surface consists of a series of plains, broken by buttes, mesas, and sierras, which are probably the worn-down stumps of parallel northwest-trending chains of mountains. The plains on close inspection prove to be basins, not always landlocked but without drainage to the sea. Near the coast many of the basins are open to the sea, and as one passes inland each succeeding basin lies higher than its neighbor, the altitude gradually increasing from sea level to 3,500 feet. Some of the basins in the western part communicate with each other, but the more eastern basins are completely shut in. In the western part the basin floor appears to be composed of solid rock covered with a thin veneer of sand and gravel. The phenomena suggest that the region is in a mature stage of the cycle of erosion in an arid climate.[12]

In the desert of Sonora the vegetation is characterized by its discontinuity. There are wide stretches where there is no vegetation, alternating with areas where there is sufficient water and soil to support a growth of cactus and spiny scrub. Mesquite, *palmo verde*, and the Sonoran greasewood are the chief arborescent forms, but it is the cactus that forms the most striking feature.

The Western Cordillera

The Western Cordillera stretches like a one-sided spine along the western coast through the length of the land. Definite information on this natural

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[11] S. F. Emmons and G. P. Merrill: Geological Sketch of Lower California, *Bull. Geol. Soc. of Amer.*, Vol. 5, 1894, pp. 489–514.

A. W. North: The Uncharted Sierra of San Pedro Mártir, *Bull. Amer. Geogr. Soc.*, Vol. 39, 1907, pp. 544–554.

Gustave Eisen: Explorations in the Central Part of Baja California, *Bull. Amer. Geogr. Soc.*, Vol. 32, 1900, pp. 397–429.

E. W. Nelson: A Land of Drought and Desert—Lower California, *Natl. Geogr. Mag.*, Vol. 22, 1911, pp. 443–474.

[12] W J McGee: Sheetflood Erosion, *Bull. Geol. Soc. of Amer.*, Vol. 8, 1897, pp. 87–112. Compare also W. M. Davis: Geographical Essays, Ch. 15, "The Geographical Cycle in an Arid Climate."

region is scant: it has been little explored, and its structure appears to be highly complex. There is, however, without doubt a system of fold mountains running in great ranges roughly parallel to the Pacific coast. These mountains are about 7,000 feet high, while many peaks rise to over 12,000 feet. The ranges are complicated by a great amount of volcanic activity, cones and lava flows in all stages of dissection occurring among them.[13] On the west the mountain flanks are more or less cut up by ravines. On the east, on the contrary, the mountains grade into the mesa region, and their flanks are not cut to anything like the same degree, since on this side the rivers are intermittent, ending in closed basins, and the gradients of the stream beds are not as steep as on the western side. The course of erosion here tends rather to lessen than to accentuate the relief.

The Cordillera embraces many zones of vegetation. The dry lower slopes of the northern part are covered with grass and mesquite, which give place to forests of oaks, mountain cedars, and pines as the ground rises and the rainfall increases. The higher parts of the mountains are forested with pine where the rainfall is deficient, but where it is abundant live oaks mingle with the pine. The timber resources of this region constitute a vast source of potential wealth. As yet difficulty of access restricts exploitation, although, even so, the forest products from some of the states, Durango and Chihuahua for example, are not inconsiderable.

The Arid Plateau of the Northeast

The arid northeastern plateau is formed of strata which still remain horizontal for the most part. Differences in climate have caused quite different erosional effects in the western and eastern parts. There are local names for the distinctive land forms of each part, which suggest distinguishing names for each region. The western part is a region of flat-topped mountains, mesas and intervening broad, level depressions. The eastern part has as its typical form of relief the closed-in, basin-like hollows known as *bolsons*, and this may be termed the bolson country. The mesas are as a rule about the same height, though there are differences in level and slight tilting due to the differential uplift. The upper portions of the escarpments which terminate the mesas are precipitous, whether through erosion or faulting; the base is often covered by extensive gravel deposits.[14]

The bolson country is situated on the east of the mesa regions. There is no distinct boundary between the two. The same general structure probably underlies each, but the surface forms have been differentiated by erosion. The relief becomes less pronounced, the level of the land lower, and the climate more arid, as one journeys eastward. The sides of the mesas become

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[13] O. H. Howarth: The Western Sierra Madre of Mexico, *Geogr. Journ.*, Vol. 6, 1895, pp. 422–438.
E. O. Hovey: The Western Sierra Madre of the State of Chihuahua, Mexico, *Bull. Amer. Geogr. Soc.*, Vol. 37, 1905, pp. 531–543.

[14] R. T. Hill: Preliminary Notes on the Topography and Geology of Northern Mexico and Southwest Texas, and New Mexico, *Amer. Geologist*, Vol. 8, 1891, pp. 133–141.

less precipitous, the streams are fewer, and none are permanent, while the plazas give place to bolsons. The bolsons are little below the general surface of the surrounding plateau, which here averages 5,000 feet in height. The basins are aggraded areas filled with waste washed down by streams or carried there by the wind. Besides bolsons other features of this country are the ever-shifting sand dunes and the monoclinal mountains which mark the edges of tilted blocks of strata.

The vegetation is sparse. The land in its natural state produces a desert flora—bunch grass, cactuses, and yuccas, and such woody plants as the mesquite and the guayule. Human occupation of the region is practically confined to stock raising and mining, save where the possibility of irrigation changes the whole aspect of affairs and renders the land exceedingly productive. An example of the transformation of semidesert into rich plantations is found in parts of the Bolson de Mapimi (Coahuila and Durango), where cotton and tobacco are grown for export, as well as food crops for home consumption.[15]

Great Central Plateau

The natural regions of the highlands already described sink into insignificance beside the great Central Plateau, the fourth and, from the viewpoint of human occupation, the most important of these divisions. It contains the great cereal region, upon which, from time immemorial, the life of the country has depended, and from its depths come the precious metals which have made Mexico of such importance to the world at large. The plateau is a triangular-shaped area stretching southeastward from an east-west line 22° 30′ N. It is bounded on the south and east by steep escarpments, cut by innumerable streams into deep ravines. On the west and north it grades imperceptibly into the Western Cordillera and the northeastern plateau, differing from the latter in climate rather than in topography. The core of the plateau is formed of ancient crystalline and sedimentary rock with igneous intrusions of various dates, the whole mass having been folded, faulted, crushed, and subjected to long-continued erosion before the uplift that ushered in the present cycle of erosion.[16] This uplift was accompanied by a tilt to the north. Thus the southern edge has been raised higher than the northern part. Some of the lines of fracture are shown in Figure 4; the great scarp faults are due to them, and along them are piled the cones produced by violent bursts of volcanic activity.[17] The present result of the long process is that there are two mountain types, residuals and volcanic cones. The older residual mountains are distinguished by rounded summits and long, low ridges. The volcanic peaks are of much greater height, completely dominating the older relief. They show the forms usually found

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[15] La República Mexicana: Coahuila, Reseña Geográfica y Estadística, Paris and Mexico, 1909, pp. 41–43.

[16] Virlet d'Aoust: Observations sur le système des montagnes d'Anahuec ou de l'Amérique Centrale, *Bull. Soc. de Géogr. de Paris*, Vol. 13, 1877, pp. 241–274.

[17] Felix and Lenk: Über die tectonischen Verhältnisse der Republik Mexico, *Zeitschr. Deutsch. Geol. Gesell.*, Vol. 44, 1892, p. 303.

in volcanic regions, cones in various stages of dissection, extensive flows, lava plateaus, etc. The group of mountains to the northeast of Mexico City is an example of the older, or residual, type of mountains, while Popocatepetl and Ixtaccihuatl are volcanic cones.[18]

The Central Plateau is by no means all mountains. Among its most characteristic features are wide stretches of level land. These are aggraded areas sometimes still occupied by shallow lakes, sometimes in a later stage, being drained by streams which have cut through the basin rims and captured the areas of interior drainage. The climate is rainy enough to cause vigorous stream action, which is rendered more powerful by the great height of the plateau. On the eastern edge the climate is the most humid and there erosion is most vigorous. The outlying district of Oaxaca, which has not had its drainage system interrupted by volcanic disturbances, is almost entirely cut off from the main mass of the plateau and offers a highly dissected surface, showing what would have happened to the entire plateau, after the uplift, had not the process of erosion been blocked by vulcanism.

The Central Plateau has many zones of vegetation. The high plains of the interior suffer from lack of rain, being grass-covered where there is sufficient moisture and suitable soil, and barren where the soil is alkaline or sandy or where local topography most completely cuts off precipitation. The foothills bordering the plains are also generally devoid of timber. The lower slopes of the mountains are covered with scrub forests. Spruce and fir forests clothe the upper slopes of some of the higher ridges while the escarpments and the outliers of the plateau have a belt of deciduous trees below the pine forests. The timber line lies at an altitude of 11,000–13,000 feet, at which elevation there are often extensive alpine meadows. The snow line is at about 15,000 feet.

The Highland of Chiapas

South of the isthmus rises the highland of Chiapas, a plateau of small dimensions, whose maximum width is only 150 miles and whose length is hardly more. Its maximum height is about 6,000 feet. As in the Central Plateau two types of relief are distinguishable. In the north there are flat-topped mesas; in the south there are sierras showing sharp ridges. In the northern part the ground rises in a series of terraces, and there is a belt of well-marked cuestas that run from southeast to northwest. There is evidence of considerable volcanic activity in this section: the southern part on the contrary has but one volcanic peak.

The vegetation of the plateau of Chiapas resembles that of the southern escarpment and the outliers of the plateau. That part which is high enough to be out of the tropical zone has a belt of deciduous trees with clearings of

[18] Ezequiel Ordóñez: Observaciones relativas á los volcanes de México, *Memorias Soc. Científica "Antonio Alzate,"* Vol. 8, 1894–95, pp. 183–196.

grassland which form rich pasture. Still higher the mountain slopes are covered with pine forests. The agricultural possibilities of the region are great; the lower slopes and foothills can be used for tropical crops such as sugar, coffee, rubber, cacao; and on the upper slopes fiber plants can be grown. The timber of the mountains forms a valuable resource.[19]

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[19] Emilio Böse: Reseña acerca de la geología de los estados de Chiapas y Tabasco, *Inst. Geol. de México Bol. No. 20*, 1905, pp. 7–20.

Karl Sapper, work cited in footnote 5, and map at the end of the volume.

THE DISTRIBUTION OF POPULATION IN MEXICO

By the late SUMNER W. CUSHING

[With separate maps, Pl. IV, facing p. 232, and Pl. V, facing p. 242.]

The manner in which the people of Mexico are distributed is especially instructive because it exhibits such striking contrasts. A densely populated plain is often bordered by an almost uninhabited region of mountains. In the dry north a section supplied with water for irrigation may have 100 people per square kilometer, while an adjacent section, equally flat and fertile, but without water for irrigation, may have practically no permanent population. Again, a malarial coastal strip is usually unoccupied save for a few squalid families of fisher folk, while a well-drained section directly back of it is densely peopled. The causes of this peculiar distribution form the subject of this article.

The characteristics of distribution appear most clearly when the population is divided into rural and urban classes. If a town contains a population of 2,000 or more persons it is considered urban, for in Mexico such a place is almost sure to have many of the characteristics of a Latin city such as a plaza surrounded by at least a few government buildings, and a large church and an important market place, and perhaps some paved streets. Moreover, in towns of such size a large proportion of the people are engaged in trade and transport, even though the business may be on a simple scale and be founded purely on agriculture. On the other hand, a great majority of the places of less than 2,000 persons are rural in the sense that they consist largely of the houses of farmers who go out to the fields each day. It must be borne in mind, however, that the differences between cities and villages in Mexico are not nearly so striking as in the United States. In the dry parts of the country even the smallest village is like a city in having the adobe houses all close together without intervening yards and gardens. On the other hand, in the wet portions of Mexico even the cities often resemble overgrown villages. In no part, however, are there many persons living on isolated farms, as is common with us. The Mexican rural population consists almost exclusively of villagers. Where the population is sparse it means that the villages are small and far apart.

Each of the two kinds of population, rural and urban, is illustrated by a map (Pls. IV and V) based on the latest census, that of 1910.[1] The maps have been carefully compiled and aside from the imperfections of the census itself are believed to be accurate. In compiling the rural map the *partidos* or counties have been taken as the unit. The population of the towns has in

[1] A map showing total population distribution is given by José Covarrubias in a publication of the Ministry of Agriculture, "Varios estudios complementarios de las leyes agrarias, Mexico," 1914. This is described as based on the *municipio* (township); the scale is approximately 1: 13,000,000.—EDIT. NOTE.

each case been subtracted, and the number of remaining inhabitants has been taken as the basis for determining the population per square kilometer. In the city map the size of about 850 towns of over 2,000 is indicated by the size and character of the symbols. In compiling this map it was surprising to find that no more than about 600 of these towns were shown on any single map, although some were on one map and others on another.

Rural Population of Mexico

Not only is the rural population of Mexico almost entirely agricultural, but the permanent wealth and prosperity of the country must depend on

FIG. 1—View from the Pyramid of the Sun at Teotihuacán looking east over the maguey fields to the pass of Apam. This broad pass is the great highway leading from Puebla and the coast region into the Valley of Mexico. (Copyright by C. B. Waite.)

agriculture, in spite of the importance of certain minerals. Indeed it is quite within bounds to say that if Mexico's rural problems were settled satisfactorily, many of the other difficulties would quickly adjust themselves. As a preliminary to the problem it is necessary to know something of the distribution of the rural population. This distribution depends largely on rainfall, altitude, and relief—for these conditions determine the success and intensity of farming.

Rainfall and Population Density

The most striking thing shown by the map of rural population is the contrast between the very sparsely inhabited country districts in the northern half of Mexico and the densely populated south-central part. The chief cause for this contrast is rainfall.[2] In the north there are fewer than five rural inhabitants per square kilometer because the rainfall is

[2] Compare with the rainfall map, Fig. 10, p. 255, and also the temperature map, Fig. 9, p. 254.

generally less than 20 inches (50 cm.), which is insufficient to water crops. Except where irrigation is practiced or mining is carried on, the people are supported by grazing. In the extreme north and northwest, where the rainfall is even less than 10 inches (25 cm.), the rural population is less than one person per square kilometer. Here grazing is relatively poor; some parts indeed are typical deserts. This most sparsely settled portion of Mexico has about the same density of rural population as our Rocky Mountain states, while the rest of the northern half of Mexico has about the same rural density as our Pacific states. Because of the scarcity of isolated farms and ranches, however, the distance from settlement to settlement is greater than in the corresponding parts of the United States.

FIG. 2—On the outskirts of Cuernavaca, capital of Morelos: in the background Popocatepetl (right) and Ixtaccihuatl (left). The sheltered valley has a delightful climate and rich soil and is famous for its production of sugar cane and fruits. (Copyright by C. B. Waite.)

The effect of rainfall is strikingly exhibited in the environs of Monterrey where a local increase of more than 10 inches is accompanied by a corresponding increase of rural population to more than 10 per square kilometer. South of this relatively favored section the rainfall diminishes a little and then increases once more. The rural population, however, does not respond as might be expected. The fact is that, although the total annual rainfall is greater than in the north, its distribution is not favorable; nearly all of the rain falls in late summer and early autumn, too late to give the crops a good start. Hence grazing is the main support of the very sparse population, and southern Nuevo León and nearly all of Tamaulipas are included in the section having less than five persons per square kilometer.

In the more densely populated south-central part the rainfall ranges from 18 to 40 inches or more, and practically all comes in summer when it is most needed. Here crop farming is successful, and the rural population rises to over 20 persons per square kilometer, about the same as that of the Middle Atlantic states of New York, New Jersey, and Pennsylvania—the

part of our country where it is densest. In certain sections where agriculture is especially favored important cities have grown up. These in turn have made it easy to market crops and to get relatively high prices, and here 50 or 60 rural inhabitants, and even more, are supported by each square kilometer, a condition similar to that existing in the environs of our own large cities. Cities which have grown up in particularly good agricultural regions and which are surrounded by particularly large rural populations include Mexico City, Toluca, Puebla, Morelia, León, and Guadalajara.

The beneficial effect of increased rainfall, however, does not continue indefinitely, for there may be too much rain. This is especially the case in regions where the rain is distributed throughout most of the year, as in southern Mexico, instead of being limited to a single season, as in the center and north. In such regions agriculture becomes extremely difficult. This is partly because the constant moisture leaches away the plant foods from the soil so rapidly that one or two crops (where a single type of plant is cultivated) exhaust the soil unless fertilizers are used abundantly and the subsoil is turned up by deep plowing—both very difficult processes for an inert tropical people with little energy and little capital. The difficulty of agriculture in tropical regions that are constantly wet is also due in part to the rank growth of native vegetation which chokes the cultivated crops. In these seemingly contradictory statements lies one of the most noteworthy characteristics of the vegetation in the moister tropical regions —its great diversity. A single species does not cover a given area and thus draw heavily on one or two special constituents of the soil, but many species grow side by side and so all are able to thrive. Thus the luxuriance of tropical vegetation can be overcome only by extraordinary energy on the part of the individual, which of course is rare in Mexico, or else by cultivating "plantation" crops such as sugar, bananas, rubber, and cacao. Such crops, however, support a dense population only when they are under the constant supervision of northern races who import food in exchange for the semi-luxuries or raw materials raised on the plantations. Hence the abundant rains and the absence of a sufficiently long dry season in southern Mexico from southern Oaxaca and southern Veracruz southward and eastward cause the rural population to be as scanty in general as in the dry north.

Altitude and Related Factors

Although rainfall is the chief factor in controlling the distribution of the rural population, its influence is greatly modified by altitude. Not only does altitude affect the amount and to some degree the seasonal distribution of rainfall, but it modifies the temperature and thus not only changes the kind of crops but alters the energy with which man attacks the difficulties of nature.

Within broad regions of favorable although variable rainfall the density of rural population varies with varying altitude. This is particularly strik-

ing in a zone across the country from Veracruz to Manzanillo. The well-watered Gulf plains are so little above sea level that their temperature is high and debilitating. Moreover, the dense weeds respond to the heavy rains, while the warm jungle breeds disease-carrying mosquitoes and other insects that make life miserable. Under these conditions the rural population remains sparse, from one to five persons per square kilometer.

As the altitude increases with distance from the coast, the temperature becomes more stimulating. The rainfall also increases; but, because of the relief, the third of the three great conditions that control the density of rural population, the rain runs off rapidly from the slopes, and there is

FIG. 3—A typical scene in the neighborhood of Mitla in the sierras of the Oaxaca plateau: here organ cacti are commonly used as hedge fences. In pre-Columbian times Mitla was a center of civilization (Zapotecan culture). Today it is a backwater far off routes of travel. (Copyright by C. B. Waite.)

no unhealthful accumulation of the water in swamps and marshes. With the increase in altitude as one approaches central Mexico the rural population rises from 5 to 10 and then from 10 to 20 persons per square kilometer when the high plateau is reached. The relatively dense population of the central plateau results almost as much from the high altitude and its stimulating temperature as from the favorable rainfall.

On the western coast as a whole the regions at a low altitude immediately bordering the sea (the coastal plain is very narrow or lacking altogether) have fewer than five rural inhabitants per square kilometer. As the altitude increases inland the density of population increases to 20 per square kilometer. Almost everywhere the higher densities of population advance toward the coast or retreat from it with the advance and retreat of the higher elevations. Thus a high plateau approaches the coast in Colima province and with it the population line of 10 per square kilometer; the same thing happens in the case of the Guerrero plateau.

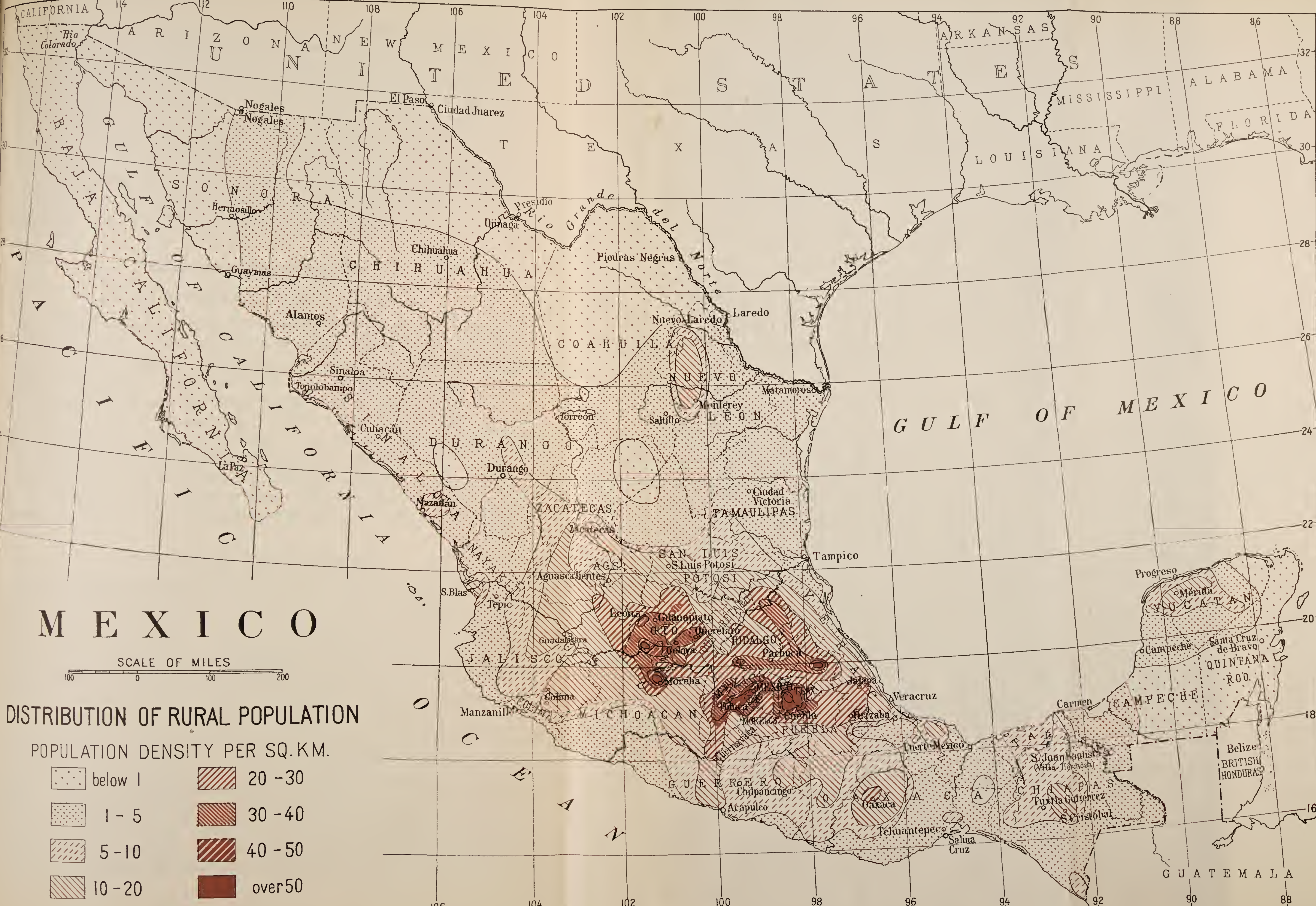
Other plateaus are equally potent in supporting a comparatively dense population. The Oaxaca plateau, almost isolated from the main body of the central plateau, has a population of from 10 to 20 or more per square kilometer. The still more isolated plateau of Chiapas supports a rural density of 10 and over per square kilometer, while all the bordering lower lands are less densely inhabited.

An exception to the influence of altitude is found in the low plains of Yucatan. Although the temperature is as debilitating as in the other lowlands, much of the northern half of Yucatan contains a rural population of over five to the square kilometer, and in about one-sixth of the state the density is over 10. The explanation lies in the relative dryness of the coastal region and especially in the sharply defined dry season and the free circulation of the air under the full exposure to the trade winds. These conditions give northern Yucatan another advantage, for they favor the growth of sisal. The region is so well suited to this fiber which is so much needed for binder twine in the United States, that modern enterprise has gone in and helped to increase the unusually large rural population which existed here even before the fiber was raised for export. Beyond the relatively dry and favored area given over to sisal in the Yucatan peninsula, the constant rains and dense jungle cause the low plain to be an undeveloped wilderness in which roams a very sparse and wild Indian population.

The Influence of Relief

In Mexico, as elsewhere, the level lands tend to support the largest rural populations because of the usual association of fine fertile soil and the ease of tillage and transportation. Yet, as we have seen in both northern and southern Mexico, if rainfall is not favorable the plains must go almost unused, except perhaps for grazing. Or if the altitude is unfavorable, as in the Gulf coastal plain, the density of rural population is low. In south-central Mexico, however, all three elements, rainfall, altitude, and relief, are favorable over broad areas; and the combination produces Mexico's densest population.

Let us consider unfavorable relief. Rugged lands generally have coarse soil, plowing is troublesome, and gullying is rapid. Farming is correspondingly arduous, and the transportation difficulties in the way of marketing surplus products are apt to be even more discouraging. The best illustration comes from the Sierra Madre Occidental. From southeastern Sonora across Sinaloa and Durango to central Tepic both rainfall and altitude are favorable for a good rural population, but relief is unfavorable. The density of rural population is between one and five per square kilometer and in one section west of the city of Durango falls even below one per square kilometer. An important part of this population is engaged in mining. Another example is in southern Chiapas where the rugged cordillera supports only a meager rural population; but, though the altitude is here favorable, the rainfall may be too heavy.



The Geographical Review, Vol. XI, No. 2, 1921, Plate IV

Ruggedness is a contributing cause of the low density of population along the western coast, for here the land begins to rise almost directly from the shore and soon becomes a maze of valleys and ravines. It might be thought that the eastern escarpment rising to the plateau from the inner edge of the Gulf coastal plain would also be rugged enough to keep down the rural population. Such is the case in part; but here even in the wildest sections are scattered innumerable pockets, parks, and valley floors, and these under favorable conditions of rainfall are ideal for corn, fruits, and especially coffee. These favored spots counterbalance the influence of a generally rugged topography and bring up the average density of rural population to 10 or 20 per square kilometer and even higher.

Urban Population of Mexico

Paucity of Important Cities in Mexico

As an almost purely agricultural country, Mexico lacks the numerous large cities that are characteristic of countries where manufacturing is important. The population is one-sixth as large as that of the United States, but the ratio of cities is much less. In 1910, of cities having over 10,000 population, Mexico had only 68 while the United States had 601, a ratio of one to nine. In the same year the United States had 50 cities exceeding 100,000 inhabitants (8 of these over 500,000) while Mexico had only two, the capital (471,000) and Guadalajara (119,000).

The important cities of Mexico are sustained chiefly by trade and not by manufacturing. Their most striking characteristic is that they are market places where the surrounding agricultural population buys and sells.

Great Number of Small Centers

When it comes to the small center with several hundred or a few thousand people Mexico has a larger share in proportion to the total population than the United States. This is the normal tendency in an agricultural region, as may be seen in states like Iowa, for the farmer needs a small market near at hand. The tendency to congregate in small towns has doubtless also been much increased by the general insecurity that has characterized Mexico for many centuries. When small bands of robbers are abroad, a compact community gives a feeling of protection, even though it entails hardship upon the farmers who have to travel several miles to and from their farms. The tendency for the people to congregate in small centers rather than live on isolated farms is also due in large measure to the water supply. In the north permanent supplies of water are so scarce that all the families of a considerable region must congregate at one spot. Even in the central plateau the long dry season in winter causes all the minor sources of water to dry up so that the farmer cannot depend on springs or wells on his own land. Hence the Mexican, even when he is a farmer, generally

lives in what may be called a center of population. Sometimes the center takes the form of an *hacienda* or plantation headquarters, but usually it is a village.

The accompanying map (Pl. V, p. 241) shows the Mexican cities in their natural grouping. The cities themselves fall into the following classes distinguished by symbols:

Class 1, Mexico City, population 471,000
Class 2, population from 50,000 to 125,000
Class 3, population from 25,000 to 50,000
Class 4, population from 15,000 to 25,000
Class 5, population from 10,000 to 15,000
Class 6, population from 5,000 to 10,000
Class 7, population from 2,000 to 5,000

To all students of Mexico the capital looms large. It rightly takes on great importance when compared with other Mexican cities, but it falls down when studied in relation to cities in other countries. Among American cities Buffalo, San Francisco, and Los Angeles rank well above it. Moreover so many of the dwellers in the capital live in adobe huts of one or two rooms, and so few require space in office buildings as well as in homes, that the city makes less impression than its size would warrant.

Of the other large cities, Guadalajara ranks with Trenton, Puebla with Tacoma, Monterrey with St. Joseph, Mo., San Luis Potosí with Charleston, S. C., Mérida with New Castle, Pa., León with Chattanooga, Veracruz with Kalamazoo, Aguascalientes with Saginaw, Mich., Morelia with Superior, Wis., and Chihuahua with San José, Cal. This comparison includes the eleven largest Mexican cities.[3] To carry the comparison farther would involve the use of American cities so small that there is little likelihood that they would be widely known.

Concentration of Cities in South-Central Mexico

The most striking feature of the city map is the concentration of cities, both large and small, in the south-central part of the country on the high Mexican plateau.[4] An egg-shaped area whose larger end is at Guadalajara and San Luis Potosí and whose longer axis extends from those cities to Oaxaca would take in the region where cities are most numerous. This is the real Mexico, the place where the rural population is densest and hence where the cities grow largest. Although it occupies only a sixth of the country, it contains more than two-thirds of the cities and nearly two-thirds of the total population. Altitude, water supply, and soil are the chief favoring factors. The altitude lowers the temperature to a degree more

[3] In the comparison figures for the United States are according to the 1920 census; for Mexico, 1910 (there being no later census and no official estimate). Mexican cities are of much slower growth than cities of the United States.

[4] Compare Professor Jefferson's map showing the situation of Mexican cities in relation to the 5,000 foot contour line, *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, p. 437, reproduced in the *Geogr. Rev.*, Vol. 3, 1917, p. 24.

favorable for work than in the lowlands while it yet remains high enough to raise some crops profitably not only in summer, but even in December and January, provided there is water. The water supply in the form of rain or irrigation water from rivers and wells is adequate in general. The soil in the level areas is deep and of high natural fertility, quite unlike the depleted soil of the far wetter southern lowlands.

Individual Groups in South-Central Mexico

While a detailed study of individual cities is not appropriate in this article, it will be helpful to divide the cities of Mexico into groups according to their geographical location. South-central Mexico contains 17 such groups as follows:

Ten Central Plateau Groups. (1) Mexico City, (2) Puebla, (3) Toluca, (4) El Oro, (5) Pachuca, (6) Guanajuato, (7) Michoacán, (8) Jalisco, (9) San Luis Potosí, (10) Río Verde.

Three Eastern Coast Escarpment Groups. (11) Southern part of Tamesi-Pánuco, (12) Veracruz, (13) Papaloapám.

Three Western Coast Escarpment Groups. (14) Oaxaca, (15) Mexcala, (16) Morelos.

One Isolated Plateau Group. (17) Guerrero.

The groups are separated from one another either by mountains, such as those between the Mexico City group and the Puebla group; by rugged valleys, as between the Guerrero plateau group and the Morelos escarpment group; or by arid stretches in which water is not available for irrigation, as between the San Luis Potosí group and surrounding groups.

Plateau Groups

One of the most interesting and important differences among the larger plateau groups is the present rate of growth. This probably depends in considerable measure upon the relative fertility of the soil. The Guanajuato plateau group and the Mexico City group serve as examples. Around the former the soil is highly fertile because of good climate and favorable chemical composition. Moreover, although the region was densely populated in ancient times, it has not been intensively farmed in recent generations as has the region near Mexico City. When Cortez entered the Valley of Mexico he found the Aztecs cultivating it, and since then cultivation has been continuous without the use of artificial fertilizers. The growth of cities on the Guanajuato plateau is rapid, while on the Mexico City plateau it is almost stationary aside from the influence of the capital. Already the Guanajuato plateau has 12 cities of the fifth rank or higher, that is with over 10,000 inhabitants, while the Mexico City plateau has only 7. All of these except one are so closely huddled about the capital that they seem to be sustained more by its influence than by the resources of the surrounding country. At present, however, cities or towns of the lowest

ranks, with 2,000 to 10,000 inhabitants, are more numerous and in more compact groups in the Mexico City plateau than in the Guanajuato plateau. This is probably due to the good rainfall. In the Guanajuato plateau, on the other hand, there are certain sections where the need of irrigation prevents the growth of cities unless an artificial supply of water is available to supplement the rainfall.

In the Puebla group the influence of good farming conditions is evident from the rather even distribution of many minor cities, while the influence of general prosperity appears in the development of the city of Puebla. That city, however, like Mexico City, has grown far larger than the conditions of the immediate environs would justify and has become the third city of the country. This rank is due partly to the religious importance of Puebla in Aztec and colonial times, partly to the recent introduction of manufacturing, especially cotton, and still more to the help of direct railway communication with three important regions: (1) Mexico City on the northwest, (2) Veracruz on the east, and (3) Oaxaca on the south.

Turning now to the minor groups on the plateau, the Toluca and El Oro groups are almost continuous with the Mexico City group and have similar plateau conditions. The Michoacán and Jalisco groups are favored agriculturally like the Guanajuato group, but they suffer from insufficient transportation. Both have only the blind ends of railway systems and are hampered by the lack of through routes. In this respect they contrast strikingly with the Puebla group. The Guerrero group, however, is still less favored, being the most isolated of the plateau groups. It is cut off on all sides by valleys and has no railway connections. It is no wonder that it lacks cities above the sixth rank, none having over 10,000 inhabitants.

Not all of the plateau groups are dependent primarily upon farming. The Pachuca and San Luis Potosí groups are supported principally by mines. Both are located in almost the driest stretch of south-central Mexico where farming is impossible except by irrigation, and this is limited by a small supply of river and well water. But nature has so endowed the adjacent hills with deposits of precious metals that the small groups of cities are well sustained. Each carries on a lively trade with the mining camps and smelts a great deal of ore.

The Río Verde group, the remaining plateau group included in the populous central plateau, is closely associated with the valley whose name it bears. It makes use of its waters for irrigation and enjoys the easy means of transportation which the valley affords in this rough region.

The Escarpment Groups

One of the most interesting aspects of the growth of cities in Mexico is the influence of the escarpments that intervene between the low coast lands and the high plateaus and mountains of the interior. At first thought, a rugged escarpment would seem to repel city growth, but between the

FIG. 4

FIG. 5

FIG. 4—Guanajuato, in a narrow mountain gorge of the Guanajuato plateau. The plateau is known alike for its agricultural resources and its mineral wealth. The capital city owes its foundation and its present importance to its rich silver mines. (Copyright by C. B. Waite.)

FIG. 5—The town of Amecameca lies at the foot of Ixtaccihuatl, upon a plain well watered by the melting snows from the mountain. (Copyright by C. B. Waite.)

stern inhospitable ridges are many smiling, flat-floored valleys and coves. These open stretches have the advantages of the plateaus in their stimulating altitudes and deep soil. Moreover, their position either gives them a good rainfall, or, failing this, they are well supplied with water for irrigation since they lie along streams that rise in the plateau.

Irrigation is of no great moment in the Veracruz section of the escarpment because there the rainfall is sufficient for the needs of the farmer, but elsewhere it is of prime importance. In fact, in the drier sections, such as the northern part of the escarpment on both the eastern and western coasts, the cities have a characteristic location in that portion of the river's course where the volume is greatest, that is just before it begins to dwindle through

Fig. 6—Querétaro, typical agricultural city whose existence depends upon the fertile agricultural lands of the Guanajuato plateau. (Copyright by C. B. Waite.)

evaporation and absorption. So narrow are these favorable limits that in many cases only one city finds room along each stream. This accounts for the line of isolated cities along most of the western escarpment.

Not only the location but the size of the escarpment cities depends on the water supply. A close inspection of a drainage map shows that the larger escarpment cities in the dry sections are on the larger rivers. Thus Hermosillo and Culiacán, two cities of the fifth rank (10,000–15,000), which is large for that part of the country, are located upon two of the largest rivers of the western coast, while the seventh-rank towns are on small streams. Such a relation, however, does not apply to the Río Grande de Santiago farther south since it flows through a region of abundant rains.

The Important East Coast Escarpment

By far the most important section of the escarpment, as the map clearly shows, is that which contains the Veracruz group of cities, including Orizaba, Jalapa, Córdoba and Teziutlan. This group has all the advantages that have been enumerated for escarpment cities in general and, in addition, an abundant rainfall and unusually good transportation, since the cities lie on

routes from Veracruz and other points on the coastal plain to Puebla and Mexico City.

The San Juan escarpment group (18) stands next to the Veracruz group in importance. Monterrey and Saltillo are its chief cities. It is given the name San Juan because the San Juan River system is the dominating factor. The special advantage of the two chief cities is that they are important railway centers on the shortest and best route from the United States to the Mexican plateau.

To the south of the San Juan group comes the escarpment city of Victoria on the Río Soto la Marina. Then comes a group of unimportant cities scattered over a large area that is associated with the Tamesi and

FIG. 7—Chihuahua, a thriving center of distribution for mines and cattle ranches in the arid northern plateau. (Copyright by C. B. Waite.)

Pánuco Rivers, chiefly with the latter. This group promises to grow rapidly in importance with the rise of Tampico.

South of the Veracruz group the escarpment swings around the side of the plateau and holds three groups of cities, the small Papaloapám group associated with the upper waters of the river system of that name, the scraggly group associated in the main with the headwaters of the Mexcala River, and the hollow group in the province of Morelos. Only the last holds a fifth-rank city, Cuernavaca. This seems to owe its importance to the close proximity of the densely populated plateau groups. Most of the "cities" are of the lowest rank, and even these are scattered. The unimportance of these three groups, as compared with the plateau groups, is due chiefly to inadequate transportation facilities. The few railroads that enter the groups end blindly within them, except one which goes on to Oaxaca to a like end.

West of Morelos the escarpment group thins to a scanty line of towns of the lowest rank. The reason is obvious. No railroad penetrates the section, and trade carried on along mule trails does not suffice to develop cities of importance.

When the escarpment line reaches the railway that runs from Manzanillo

to the interior it expands to include a small group of cities with Colima, a city of fourth rank, as the nucleus. It expands, too, a little to the northwest to include the group centered about Autlán (19). Here the terrain partakes of the nature of a detached plateau as much as an escarpment. Surprising as it may seem, the port of Manzanillo (1,503) is too small to appear on the map, even though it is a railway terminal. Northwest of Autlán the escarpment cities form merely a thin line for 800 miles to Hermosillo beyond which the escarpment ceases to exist.

The Cities Groups in the Northern Deserts

As might be expected, the desert cities of Mexico are grouped according to river systems, water being the prime factor. Water is so scarce, however, that irrigation is limited. Although ranches are widely distributed over the whole region, it usually happens that the main dependence for the food supply is placed upon a distant region like south-central Mexico or the United States. The cities are sustained by trade in these commodities with the surrounding mining camps and ranches and by transportation and industries related to minerals and cattle. This explains how such towns can grow up in regions where there is almost no population outside them, as appears on the map of rural population.

The Rio Conchos Group

This group (20) lies along the Rio Conchos, the first large river system in Mexico south of the United States border. Numerous tributaries rise in the eastern slopes of the Sierra Madre Occidental and flowing to the northeast unite to form the trunk stream which empties into the Rio Grande near Presidio. As the main stream flows across the dry sandy desert of the eastern part of the province of Chihuahua it dwindles greatly and in dry seasons disappears altogether. Hence we find no cities along this portion of the course: they are all located on tributaries that are small but perennial.

Chihuahua, on the Chubiscar tributary, is the lion of the group. With the dammed up waters of the Chubiscar the city is well supplied for washing and drinking purposes and can carry on some irrigation. But the main support of the city is trade with the highly successful mines in the vicinity and the ranches of the rich grazing lands to the west. This trade is facilitated by two important railways, one being the main line from El Paso to central Mexico. Parral, near the southern end of the group, is the counterpart of its northern associate in relation to ranches and mines, but, being on a branch of the main railway, it is handicapped in transportation.

The Laguna Group

The Laguna group (21) is located partly in a broad basin, known as the Laguna District, and partly along the two chief rivers that empty into the

basin, the Rio Nazas from the southwest and the Rio de Nieves (or Aguanaval) from the south. On the western edge of the basin is Torreon with two important suburbs, Gómez Palacio on the northwest for manufacturing and Lerdo on the west for the better class residences. These three form the nucleus of the whole group.

Because of a good supply of water for irrigation and because the flat floor of the basin, an old lake bottom, is ideal for water distribution, farming is more successful than in connection with any other desert group. Two products stand out notably, cotton and wheat. The Laguna District is Mexico's chief cotton section, and more wheat is raised there than is needed locally. All other food products, however, are imported. The Laguna group of cities, therefore, thrives on trade in cotton, wheat, imported foodstuffs, and the products of neighboring mines. A local plexus of railroads cares for the needs of the basin, and it is connected with outside sections by railways running south to the Mexican plateau, east to Monterrey, northwest to El Paso, and southwest to Durango.

All the other groups of the northern deserts and arid lands are based primarily on minerals; the coal group is centered around the Sabinas basin; the iron group around Salinas Hidalgo; the Monclova group has mines of its own, but more important still is the smelting carried on with coal from the north and iron ore from the east (22). Both the Matehuala (23) and Zacatecas (24) groups are founded almost literally upon silver and have other valuable mineral deposits.

The Groups of Cities of Southeastern Mexico

There remain to be treated seven groups of cities located in southeastern Mexico. Two of these, the groups of the Tuxtla and Chiapas, are merely small isolated groups that possess most of the advantages of those already described on the escarpments since they nestle in coves at considerable altitudes, the first on the flanks of the Tuxtla volcano (25) and the other in the valley of the Río Chiapas as it traverses the Chiapas plateau (26).

The other five groups are situated at low altitudes and have sufficient rains, hence they are founded upon farming and trade in tropical products destined for temperate countries. The most conspicuous of these is the Sisal group of Yucatan (27). Its center is Mérida, a city of second rank; and it is blessed with a network of railways to collect the valuable sisal fiber destined chiefly for the rope factories of the United States. If the use of sisal for binding twine were to be given up, this group of cities would suffer a severe blow but would probably still prosper, as they have long done, because northern Yucatan is apparently the best of the Mexican lowlands in climate.

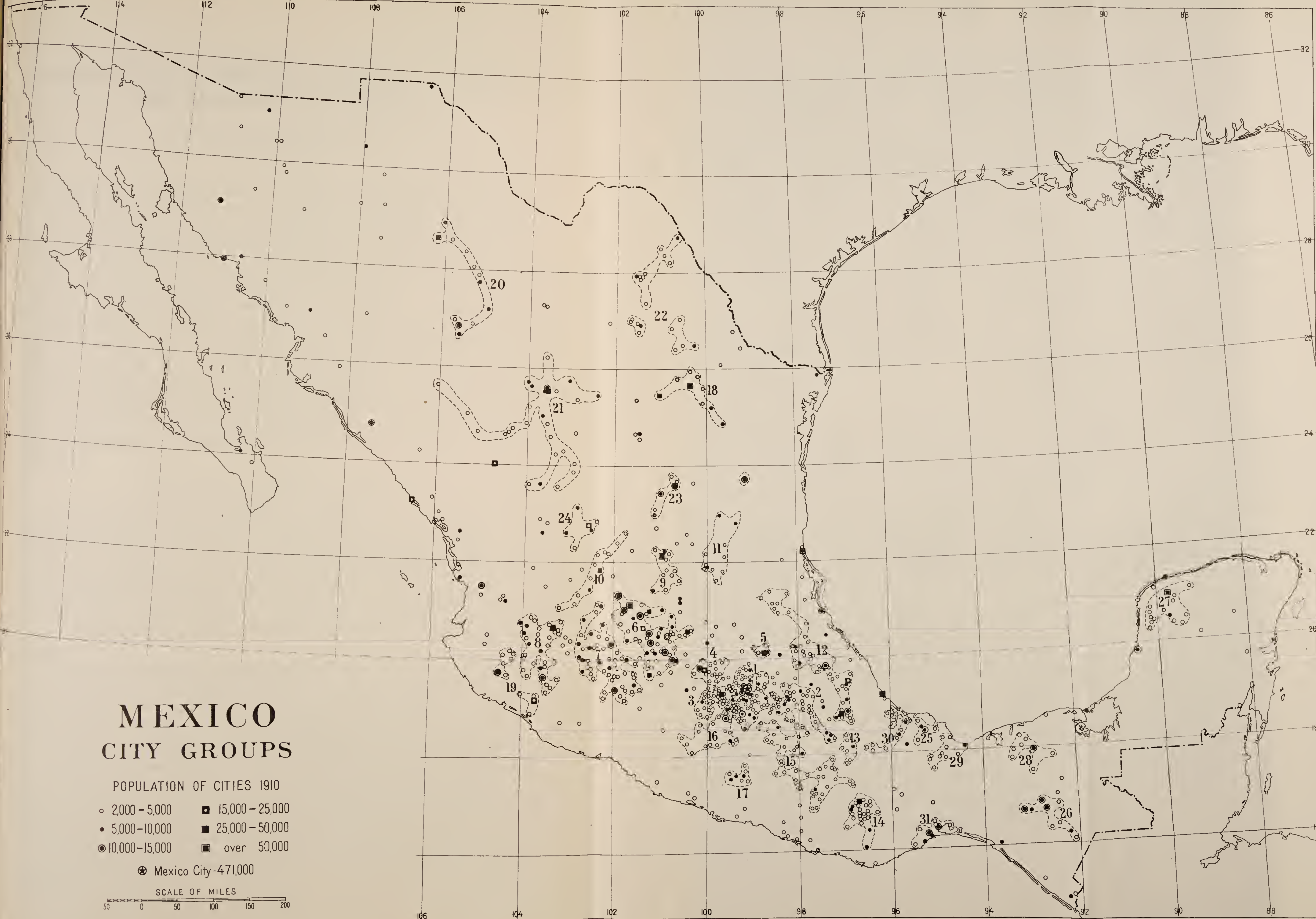
The economic backbone of the group centered around San Juan Bautista (28), now called Villa Hermosa, is the banana, although other tropical products are important, such as cacao, sugar, and cabinet woods. From its headquarters at Frontera the United Fruit Company extends its influence over

the whole group and accumulates its products over an extensive system of navigable waterways. A short railway links the Grijalva River system with the Usumacinta.

The other three lowland groups, the Puerto Mexico group (29), the Papaloapám Valley group (30), and the Tehuantepec group (31), are supported by a variety of tropical products. Chief among them are rubber, coffee, sugar, bananas, coconuts, and vanilla. The Tehuantepec group shows the influence of the Isthmian railway.

Lack of Groups Centering at Seaports

It is noteworthy that the seaports of Mexico, excepting the minor ones of Puerto Mexico and Salina Cruz, are not members of city groups. Tampico, Tuxpan, Veracruz, Campeche, Progreso, Acapulco, Mazatlán, and Guaymas are all isolated. Each is located on the hot, wet, malarial lowlands, and the population remains in the city merely to profit by the passing of imports and exports. Other cities in the vicinity would not share in this profit, and, on the other hand, there are several conditions to discourage their growth. This is why several relatively well-known Mexican seaports like Manzanillo and San Blas fail to appear on the city map. The conditions of health are so bad that the ports fail to attract as many as 2,000 persons.



The city groups on the map are referred to by name and number in the text.

The Geographical Review, Vol. XI, No. 2, 1921, Plate V

THE RELATION OF HEALTH TO RACIAL CAPACITY: THE EXAMPLE OF MEXICO*

By Ellsworth Huntington
Yale University

In geography and history few words play a more important part than "race." Yet few ideas are more vague than those indicated by this word. It is doubtful whether the true qualities of any race on earth can be accurately defined. This is because what we call racial character is a compound of three distinct items: (1) innate physical and mental characteristics, which are the result of inheritance and are thus truly racial; (2) the effects of training, that is of education, religion, government and other institutions, which combine to determine the way in which the innate capacities shall be directed; and (3) health and vigor, which determine the energy with which a people uses its innate powers in the pursuit of the ends inculcated by training. In the present paper I propose to take the last of these three, namely, health and vigor, and after showing how it is measured, show how it is related to geographical environment. The specific example of Mexico will be taken to show how health plays a part in determining racial character.

Mortality as a Measure of Health

The death rate is almost universally recognized as the best measure of the health and vigor of a community. Except in the rare case of epidemics like the influenza epidemic of 1918, physicians find that in unhealthful seasons there is always a premonitory wave of minor ailments followed by a wave of severe sicknesses, and then by a wave of deaths. The ratio between these three conditions—minor ailments, severe sicknesses, and deaths—doubtless varies from country to country, but the same general principle applies everywhere.

For the United States as a whole we can form a fair estimate of this ratio, and that will serve as a guide elsewhere. In the "registration area" of this country (which now includes 72 per cent of the population) the annual death rate is now about 14 or 15 per thousand of the population. This means that the average individual lives approximately 35 years. During the adult portion of those 35 years each person who is actively at work has on an average about 6.6 days a year of illness severe enough to require a doctor, as we know from recent surveys made by the Metropolitan Life Insurance Company. Since there are also sick days when the doctor is not

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* The author's article, "The Factor of Health in Mexican Character," *Journal of International Relations*, Vol. 11, 1920, which should be read in connection with the above, takes up the same discussion from a social standpoint.

called, since children and old people have more sickness than persons in the prime of life, and since persons not strong enough for steady work are not included in the Insurance Company's figures, it seems safe to say that the average person has 8 or 9 days per year when he is not well enough to be at work, or nearly 300 such days during the average lifetime of 35 years.

Table 1—Comparison of Death Rates in Various Cities of the World

City	Years	Average Deaths per Thousand
Amsterdam	1901–1913	12.6
London	1901–1913	14.7
Copenhagen	1901–1913	14.7
Berlin	1901–1913	15.2
St. Louis	1901–1913	16.3
Vienna	1901–1913	16.7
Paris	1901–1913	16.9
Denver	1901–1913	17.2
New York	1901–1913	17.3
San Francisco	1901–1913	17.7
Havana (a)	1907–1911	18.7
Budapest	1901–1913	19.2
Baltimore	1901–1913	19.4
Petrograd	1901–1913	22.6
Moscow	1901–1913	26.1
Calcutta	1910–1912	26.1
Madrid	1905–1908	28.6
Johannesburg (b)	1903–1912	29.5
Panama	1912–1916	30.1
Bombay	1910–1912	37.0
Madras	1910–1912	38.7
Veracruz	1910–1913	41.2
Mexico	1901–1913	45.7
Cairo (c)	1910–1916	49.2
Lucknow	1907, 1910, 1911	58.5

(a) The rate given for Havana is probably too low as it is more than likely that many deaths are not reported.
(b) Natives and Eurafricans only.
(c) Egyptians only.

As to minor ailments few statistics are available. It has been found, however, by the New York State Commission on Ventilation under the chairmanship of Professor C. E. A. Winslow, that at all times during the winter an average of a tenth of the New York school children have colds or other diseases of the respiratory organs aside from tuberculosis. Such diseases in severe forms cause a sixth or a seventh of all deaths. This means that for each death from respiratory diseases there are 50 colds, or an average of a cold and a half per year during an ordinary lifetime. This figure appears too small, for the average person certainly suffers from colds at least two weeks

per year. If a similar ratio prevails between deaths and minor ailments of other types such as headaches, indigestion, anaemia, nervous affections, and diseases of the circulatory system, the average person, even in the more healthful parts of the United States, has some minor ailment about half the time. Hence we may roughly frame our ratio thus: For one death there are about 300 days of severe sickness and 6,000 days of minor ailments. If the death rate elsewhere is double or treble the rate in our own country, the little ailments and the sicknesses which do so much to prevent us from doing our best work and being our best selves are also much more numerous than here. How great an effect such ill health must have on "racial character" and on civilization, each reader can judge by a comparison of the achievements of himself and his friends when they are feeling their best and when they are "under the weather."[1]

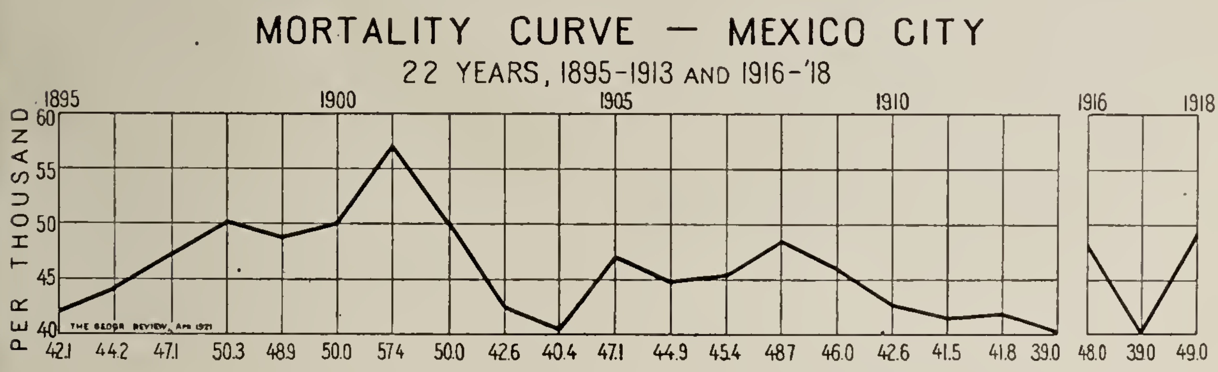

FIG. 1

The Appalling Death Rate of Mexico

Let us now turn to Mexico and see how its death rate compares with that of other parts of the world. The available statistics are scanty and inaccurate. Nevertheless they at least show the minimum mortality. Since many deaths are not recorded, the figures err on the side of giving Mexico a fair name. In only two places, Mexico City and Veracruz, are they sufficiently full to be worth using for our present purpose, but fortunately these two places represent the two main types of environment, namely, the high central plateau where the great majority of the people live, and the coastal lowlands.

All parts of Mexico, including even the plateau, appear to be terribly handicapped by ill health. How bad the conditions are on the plateau may be judged from the statement of a Mexican official named Pani,[2] who in 1916,

[1] Since this article was written Mr. Wallace Thompson has called my attention to the fact that owing to the lack of medical care fatal illnesses in Mexico are generally of shorter duration than they are in the United States. The fact that of the 467,985 deaths registered in Mexico in 1910 only 139,008 were listed as "classified by doctor," and 328,957 as "unclassified" seems to indicate that two-thirds of the deaths occurred without medical attendance. Moreover, under such circumstances minor ailments develop into severe illnesses sooner than in this country. Hence, each death is associated with less than the 300 days of severe illness and the 6,000 days of minor ailments which seem to be the average in the United States. Even so, however, the amount of illness among the Mexicans must be far in excess of what prevails among us.

[2] A. J. Pani: Hygiene in Mexico [City]: A Study of Sanitary and Educational Problems, New York and London, 1917. Reviewed in the *Geogr. Rev.*, Vol. 8, 1919, p. 200.

by order of President Carranza, made a study of the health of Mexico City. In his book he makes the remarkable assertion that Mexico City "is, assuredly, the most unhealthful city of the whole world." Coming from a Mexican, and a Mexican official at that, this is truly astonishing, but it is close to the truth. In Table I the death rate of Mexico City from 1901 to 1913 is compared with that of twenty-four other cities during the same period, so far as the available figures permit, while Veracruz is given for 1910–1913. It is not surprising to find Veracruz worse than Bombay and Madras which much resemble it in climate, but it is surprising that the death rate of Mexico City is exceeded only by that of Cairo in Egypt and Lucknow in northern India. These two cities are preëminently unhealthful

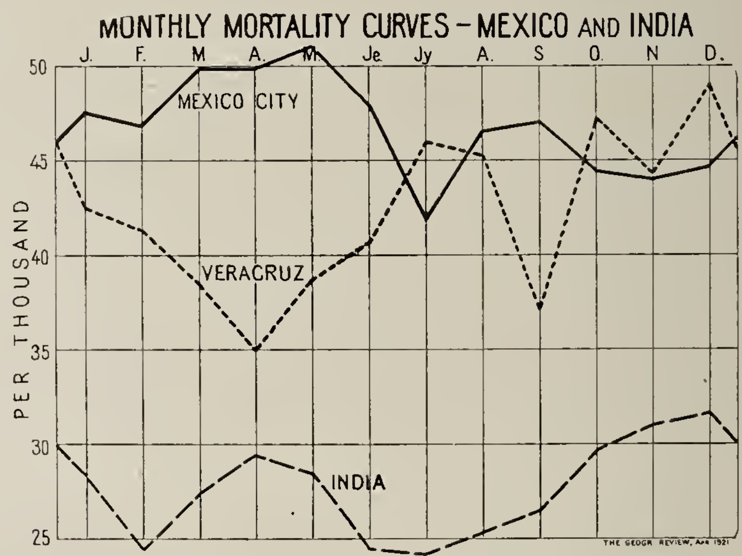

FIG. 2—Graph comparing the seasonal death rates in Mexico and India. The Mexican highland is represented by statistics for Mexico City, 1895–1918, the lowland by Veracruz, 1911–1913; statistics for India are for the period 1905–1914.

even in their unhealthful countries, for all the cities of Egypt had a combined death rate of 38.6 for 1909–1916 as against Cairo's 49.2 for 1910–1916; while Lucknow is twice as unhealthful as hot, tropical Calcutta and about half as bad again as the still more tropical cities of Bombay and Madras. When it is remembered that in Mexico City there is probably more negligence in recording deaths than in any of the other cities, except perhaps Havana and Veracruz, and hence that the death rate is really higher than the figures indicate, it is evident that we are dealing with one of the most unhealthful of all the places where people live in large numbers.

Reasons for High Mortality in Mexico City

In view of the fact that the Mexican plateau has usually been considered one of the most healthful parts of the tropics, this conclusion is not only surprising but disconcerting. The mind at once inquires whether there may

not be special, local causes of ill health which can easily be eradicated. Pani says that there are two such causes. One is the location of Mexico City in an old lake bed, and the other is the poor sanitation of the city. Both causes are real, but neither offers more than a partial explanation of the extremely high death rate. The old lake bed, as Pani truly says, becomes wet and swampy in the rainy season, but this does not increase the death rate. It might do so if the swamp harbored malarial mosquitoes, but Mexico City is almost free from malaria (see Fig. 3). As a matter of fact the death rate of Mexico City diminishes markedly during the rainy season in summer, as appears in Figure 2, and is lowest at the very time when the lake bed becomes most swampy.

Pani's other reason is that Mexico City is crowded and unsanitary, poorly fed, poorly housed, poorly governed, and subject to epidemics. Hence its death rate is higher than that of the surrounding country districts and does not truly represent the potential healthfulness of the Mexican plateau. This is undoubtedly true, but making due allowance for the disadvantages inherent in a large city it still appears that the death rate is abnormally high. Moreover, the entire Federal District shares with Mexico City its unenviable conditions of bad health. The following table shows the high mortality in the suburban "municipalities." These municipalities are not simply urban centers, but each contains a considerable rural section, that of Xochimilco covering 204.3 square kilometers, that of Milpa Alta, 277.1, and that of Tlalpam, 317.5. Moreover several of these towns with their surrounding territory stand well up off the flat valley floor and, as appears from their population, are not large cities.[3]

TABLE II—MORTALITY IN THE SUBURBAN MUNICIPALITIES OF THE FEDERAL DISTRICT, MEXICO (1911)

MUNICIPALITY	TOTAL POPULATION	AREA IN SQ. KILOMETERS	DEATH RATE PER THOUSAND
Tacubaya	37,552	65.1	35.6
Tacuba	36,078	13.9	30.7
Xochimilco	30,093	204.3	36.7
Ixtapalapa	24,507	161.6	43.8
Mixcoac	21,812	28.8	42.3
Guadalupe Hidalgo	18,344	75.0	52.0
San Angel	16,734	95.2	45.9
Milpa Alta	16,268	277.1	39.0
Tlalpam	15,448	317.5	36.4
Atzcapotzalco	14,419	37.5	39.4
Coyoacán	13,230	57.7	43.0
Cuajimalpa	5,193	87.1	34.6
Federal District	720,753	1,498.8	43.7

[3] Data from Pani, *op. cit.*, p. 38.

It will be seen that the death rate nowhere falls below 30.7, while in the municipality of Guadalupe Hidalgo, virtually a part of Mexico City, it goes as high as 52 per thousand.

Pani might well have gone farther in pointing out that the high death rate of Mexico City is due in part to the poor administration of the Mexican government, and to the complete lack of sanitation. Nevertheless, it is doubtful whether an efficient European government such as Great Britain could reduce the Mexican death rate as low as that of Calcutta, for example, although that city has the disadvantage of being hotter, damper, and larger than the Mexican capital. The reason for thinking this is that the British have not succeeded in doing so in cities like Cairo, Lucknow, and various others of northern India. Even in Johannesburg, which has an advantage over Mexico City in latitude, rainfall, change of seasons, age of the population, and size of the city, British rule has reduced the death rate only to about 29.5.

Climatic Causes of Mexican Ill Health

The great cause of most of the poor health of Mexico appears to me to be the climate. Our task is to find out what particular elements of the climate are most important. The common idea is that damp steady heat is much the worst condition, while dry clear air at a moderate temperature is supposed to be much the best. The facts, however, by no means bear out this conclusion. Omitting Havana because of the doubtful character of its statistics we may divide the tropical or almost tropical cities of Table I into three groups:

(1) *Low, moist, and hot:* Calcutta, Panama, Bombay, Madras, and Veracruz. Average death rate 34.6

(2) *High, dry, and cool:* Johannesburg and Mexico City. Average death rate 37.6.

(3) *Low, dry, and hot:* Cairo and Lucknow. Average death rate 53.8.

Of course the number of cities in these three groups is by no means enough to lead to positive conclusions. Many other facts, however, point so clearly in the same direction that we may regard the groups as typical. They lead to the following conclusions:

(1) Tropical highlands have by no means the advantage in health that is usually supposed.

(2) Dry tropical regions are in general worse than those that are moderately moist, provided we consider only those places from which such scourges as malaria and yellow fever have been eliminated.

(3) Among the well populated parts of the tropics undue dryness on the one hand and monotony on the other do almost as much harm as high temperature. This does not mean that extreme humidity is good, but the point that we are here making is that, in spite of the popular impression to

FIG. 3

FIG. 4

FIG. 3—The highest and the driest parts of Mexico are the freest from malaria. In the low parts and the moist parts, as would be expected, the disease increases rapidly during the rainy period and immediately after its close.

FIG. 4—The significant feature of this map is that dysentery increases enormously in the lowlands and in the more southern parts of the country. The monthly instances of the disease show how steadily it increases through the summer season when fresh fruits and vegetables are most abundant. It increases at a time when the death rate in general diminishes.

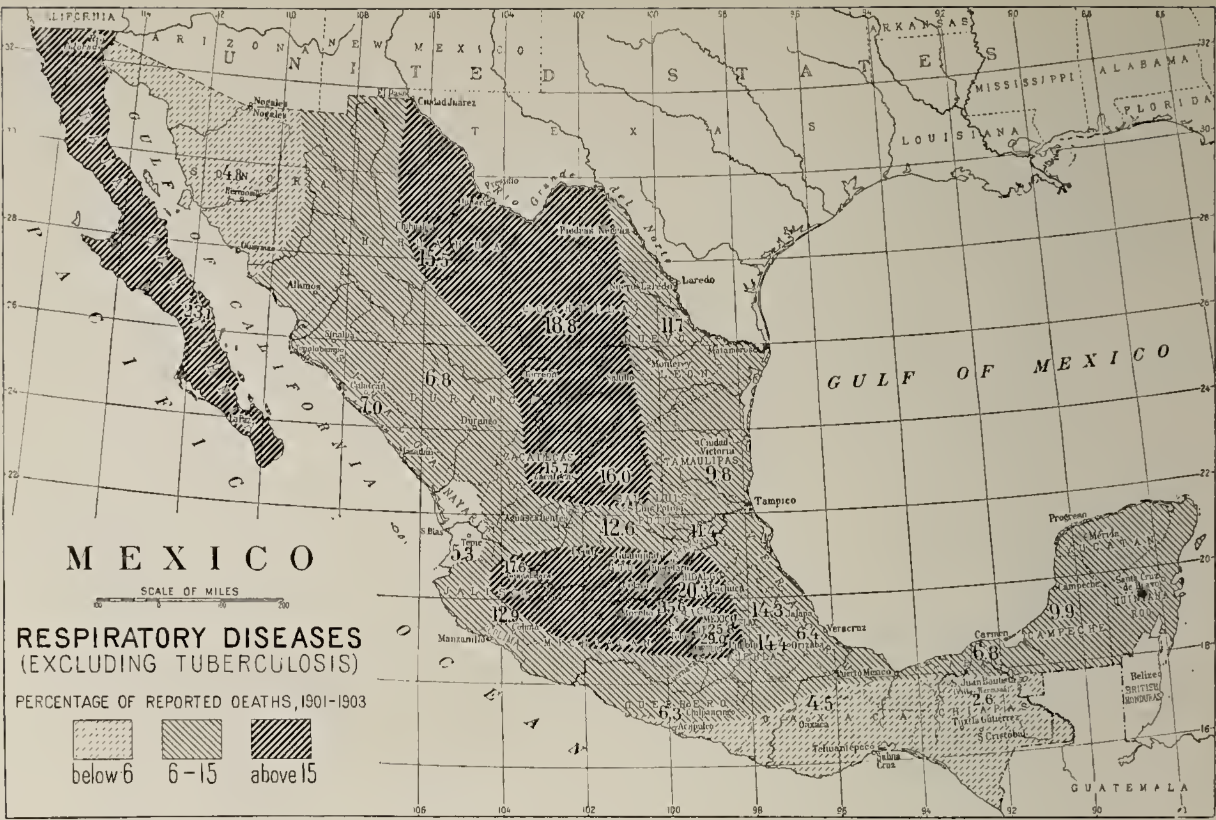

FIG. 5

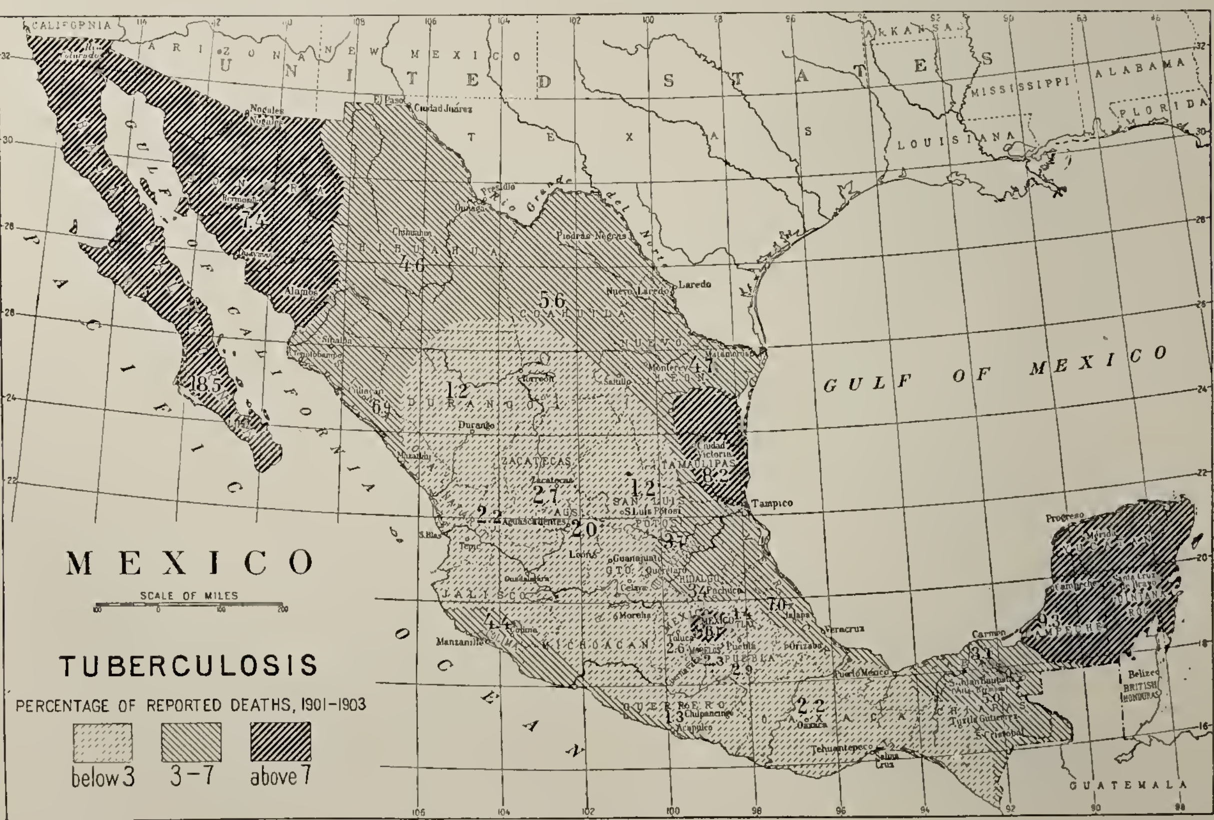

FIG. 6

FIG. 5—Respiratory diseases are much the worst at the highest altitudes. This map affords one of the best indications of this fact, but it also seems to indicate that respiratory diseases are severe in the drier parts of the country. The figures for Lower California and Sonora are based on so small a number of deaths that they are of little value. The state of Nayarit should be shaded with the lightest tint.

FIG. 6—The contrast between the maps for tuberculosis and for other respiratory diseases is remarkable. Except in Mexico City, where there is a great increase, the highlands seem to have the least tuberculosis while the lowlands and the dry parts of the country have the most.

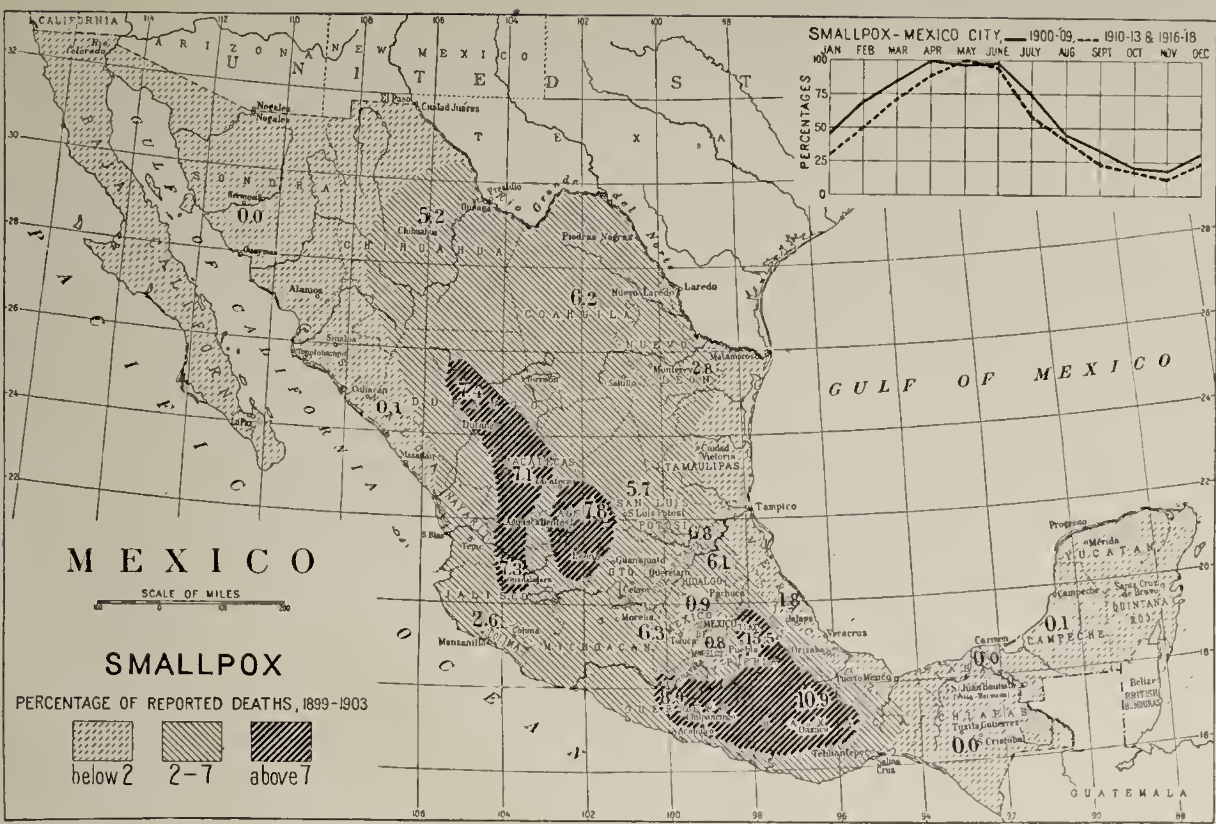

Fig. 7

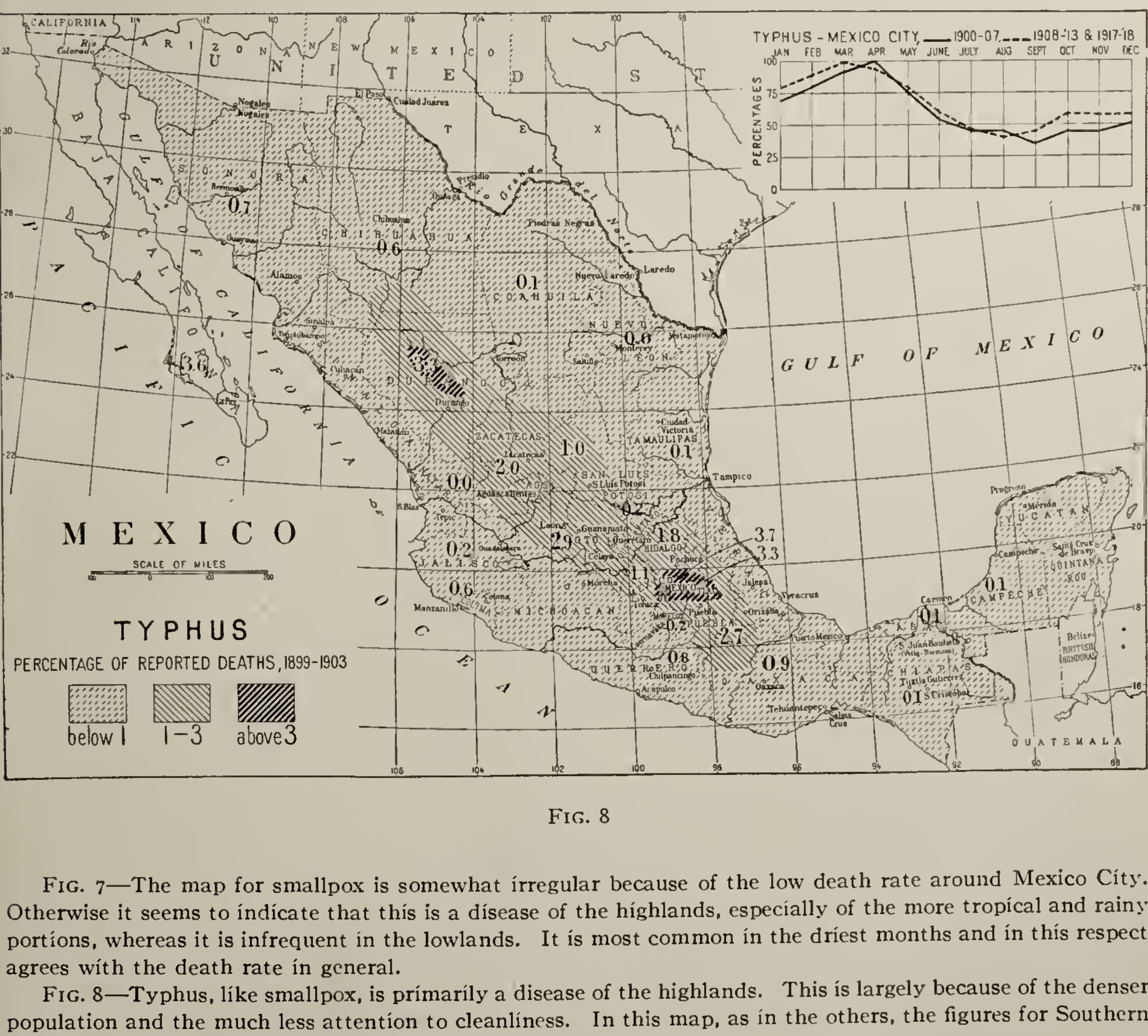

Fig. 8

Fig. 7—The map for smallpox is somewhat irregular because of the low death rate around Mexico City. Otherwise it seems to indicate that this is a disease of the highlands, especially of the more tropical and rainy portions, whereas it is infrequent in the lowlands. It is most common in the driest months and in this respect agrees with the death rate in general.

Fig. 8—Typhus, like smallpox, is primarily a disease of the highlands. This is largely because of the denser population and the much less attention to cleanliness. In this map, as in the others, the figures for Southern California are on too small a basis to be significant.

the contrary, dry heat is not so good as that with a reasonable amount of moisture.

The Effects of Atmospheric Moisture

This conclusion as to humidity is so contrary to accepted beliefs and at the same time so important that further evidence is needed. Let us take the number of deaths at different seasons in Mexico City as shown in Figure 2. The most notable feature of Figure 2 is that the death rate increases from a minimum in November to a maximum in May. This can have nothing to do with the temperature; for, while the death rate increases with the coming of cool weather and is fairly low in January when the mean temperature is 53°, it keeps on increasing until May, the warmest month, with a mean temperature of 65°. This latter figure is practically the optimum, or most favorable temperature for mankind in general.[4] Yet at this temperature the health of the Mexican plateau is at its worst. Something else seems to be the controlling factor, and that something is apparently dryness, or else some condition such as too much light or dust which goes with dryness. There is an almost regular increase in the death rate throughout the dry season. April and May are the dryest months of the year and have the highest death rate. Then during June the rains begin, and the death rate falls markedly and drops off thirteen per cent in the next two months. After the rainy season has passed its height the death rate begins to increase a little but declines slightly once more under the stimulus of cooler weather only to increase with the dry warm weather of spring.[5]

Mexico is not alone in its indications as to the harmfulness of dry air. In India, as appears in the ten-year seasonal curve of Figure 2, the dry winter season, in spite of its more favorable temperature, is much less healthful than the wet season in summer. An example from quite a different climatic region is also worth citing. In Boston an examination of all the operations for five years at one large hospital and for ten years at another shows that the weather has the same effect on operations as on the health and vigor of the community as a whole.[6] Let us take all the days at Boston when the temperature at 8 A. M. on the day after the operation ranged from 40° to 70° F., thus corresponding to the range at Mexico City throughout the year. If we divide these days according to the relative humidity at 8 A. M., we get the number of deaths per day at the two hospitals (Table III).

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[4] Ellsworth Huntington: World Power and Evolution, Yale University Press, 1919.

[5] In seeking the cause of the ascending mortality curve during the dry season in Mexico City it would seem necessary to consider also the effect of the great amount of dust in the air that is breathed. So fine is the alluvial sediment deposited formerly in the lake bottom but now exposed by desiccation of the lake that the slightest breeze raises it into the atmosphere. For weeks at a time the near-by mountains are completely obscured by this haze which hangs over the city. Its presence in the air during this dry season must greatly aggravate all such diseases as affect the respiratory organs. The summer rains clear the atmosphere and lay this dust, thus restoring the mountain air to its wonted purity.—Edit. Note.

[6] Ellsworth Huntington: Air Control and the Reduction of the Death Rate after Operations, *Modern Medicine*, Chicago, Vol. 1, 1919, pp. 463–468 and 555–558.

The driest days with a humidity of 60 per cent or less have a death rate 20 to 40 per cent greater than the moistest days. But at Mexico City and throughout the larger part of the plateau where the majority of the Mexicans live, most of the winter days and more than half those of the whole year fall in a group as dry as the driest group in Boston. Hence it appears by no means accidental that the dry cities in Table I are the ones that show the highest death rate.

TABLE III—DEATHS PER DAY AT BOSTON HOSPITALS AFTER OPERATIONS

Temperature at 8 A. M.	Relative Humidity at 8 A. M.			
	Under 60	61–80	81–100	91–100
61°–70°	0.415	0.391	0.381	0.346
51°–60°	0.460	0.395	0.334	0.271
41°–50°	0.503	0.440	0.444	0.415

EFFECT OF HUMIDITY AT HIGH TEMPERATURES

In our surprise at the effect of dryness we must not overlook the equally adverse effect of extreme humidity at high temperatures. This is illustrated by the dotted line in Figure 2 which shows the seasonal variations in the death rate at Veracruz from 1910 to 1913. In the warm lowlands of Mexico the winter months are better than those of summer not only because they are cooler, but because they are drier. The effect of humidity at high temperatures is admirably illustrated by the following figures showing deaths after operations at the Boston hospitals when the thermometer is above 70° at 8 A. M.

TABLE IV—DEATHS PER DAY AT BOSTON HOSPITALS AFTER OPERATIONS WHEN THE TEMPERATURE IS OVER 70° F. AT 8 A. M.

Relative Humidity	Deaths per Day	Relative Humidity	Deaths per Day
Under 40	0.937	71–80	0.347
41–50	0.489	81–90	0.500
51–60	0.244	91–100	0.775
61–70	0.280		

Table IV shows clearly that at high temperatures people's health is remarkably sensitive to extremes of either dryness or moisture. The Mexican lowlands and the northern parts of the plateau have a great many days of high temperature, and most of these unfortunately are either much too moist or much too dry.

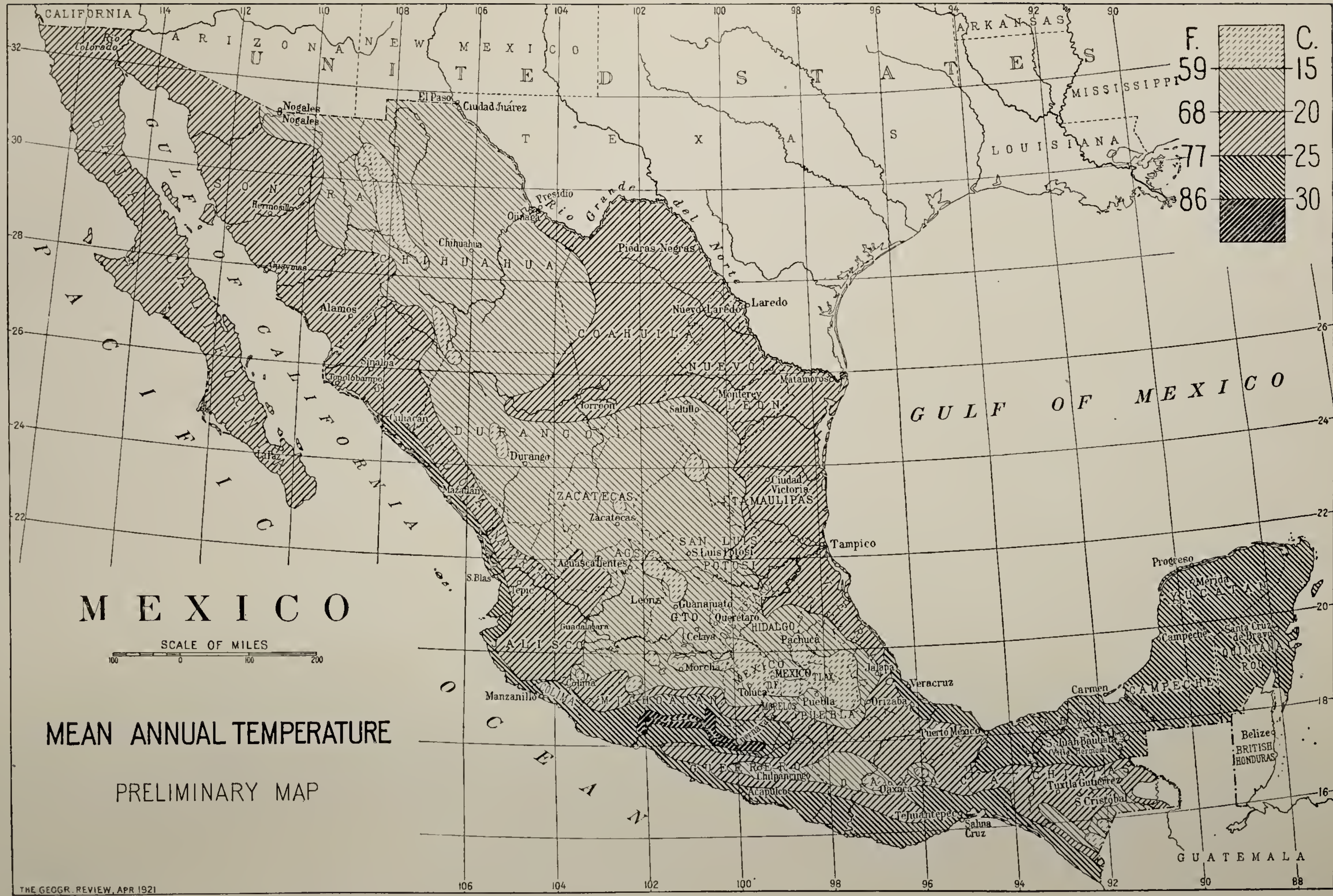

Fig. 9—The map of mean annual temperature is based almost entirely on the map by P. P. Calvert in F. D. Godman (edit.): Biologia Centrali-Americana, Zoology, Vol. Neuroptera (Odonata), London, 1892–1908. The data on which this map was based were published in the *Monthly Weather Rev.*, Vol. 36.

FIG. 10—The map of mean annual rainfall is based on all the data which were available in 1919 in the files of the U. S. Weather Bureau. These files were kindly placed at the disposal of the compiler, but the Weather Bureau has no responsibility for the compilation. All records of more than five years' duration were used. While the general indications of the map are correct, the rainfall of Mexico varies so greatly in short distances that the ultimate map will be much more complex than the present one. In particular more data are required for the Pacific coast south of Mazatlán.

The Relation of Temperature to Health in Mexico

Having seen how unfavorable are the conditions of relative humidity in Mexico, let us now see what effect the temperature has upon the health and energy of both the body and the mind. Table V shows (1) the mean temperature of the coldest month, (2) of the warmest, (3) the difference between these two, and (4) the altitude of some of the chief places in Mexico.

Table V—Temperatures of Some of the Chief Places in Mexico

(*In degrees Fahrenheit*)

City or Town	Mean Temperature of Coldest Month	Mean Temperature of Warmest Month	Seasonal Range	Altitude (*in feet*)
1 Oaxaca	63°	73°	10°	5162
2 Mexico City	52°	65°	13°	7500
3 San Luis Potosí	55°	71°	16°	6200
4 Zacatecas	52°	66°	14°	8200
5 Durango	54°	73°	19°	6200
6 Saltillo	53°	73°	20°	5400
7 Monterrey	56°	85°	29°	1600
8 Matamoros	63°	84°	21°	Sea level
9 Veracruz	70°	82°	12°	Sea level
10 Mérida	72°	83°	11°	Sea level
11 Salina Cruz	75°	82°	7°	Sea level

The table is arranged in such a way that stations 1 to 6 represent the high plateau, the best part of Mexico as regards temperature. Stations 7 and 8 represent the northern lowlands which are an intermediate region, while 9 to 11 represent the southern lowlands, the worst part of the country. Let us begin with the southern lowlands. Even at Veracruz the mean temperature of the coldest month for day and night together is 70° F., or six degrees higher than is best for physical health as proved by the study of millions of individuals, and nearly 30° higher than that which stimulates the people of more northern lands to plunge into their work with redoubled energy each year at the approach of winter. In summer the temperature for night and day together averages 82°–85°, which is more than 10° higher than the hottest month in New York City. The absolute maximum in New York, to be sure, is higher than in these tropical regions, but that is of slight importance compared with the enervating way in which day after day and month after month the thermometer rises to 90° or more each noon in the Mexican lowland. People simply cannot be energetic. It is not a matter of choice, but of actual physical inability. For a short time, to be sure, they may rouse themselves to great exertion, but the weariness thus induced demands a long period of recuperation. If people

are to maintain even the low state of vitality which passes for health in the tropics, they must go at things easily and slowly, or else must have long periods of rest. Even so, they are afflicted with minor and generally unrecognized ailments most of the time. They never know the zest and vigor that make work not merely easy but often delightful under a more favorable climate.

Turning now from this worst part of Mexico to the best part, we find that in our table the more populous part of the highland is represented by Mexico City, San Luis Potosí, and Zacatecas. The regions typified by these places contain about half the people of Mexico and are much the most important sections. So far as mere physical activity is concerned, the mean temperature is excellent. The average winter temperature for day and night together ranges from 52° to 55°, while the summer temperature varies from 65° to 71°. Thus much of the year the temperature is close to the optimum for physical health. Perhaps this is one reason why the Indians of the plateau are comparatively strong and active and are able to run astonishing distances with heavy loads on their backs. Nevertheless, as we have already seen, the death rate is three times as high as in the best part of the United States or England. The extreme dryness of the long winter presumably has much to do with this, but the lack of variability is also important. While the winter weather is very pleasant, the temperature rarely falls low enough to cause frost, and the conditions which prcduce the maximum mental stimulus are rarely reached. Worse than this is the fact that the change from season to season is comparatively slight; and worst of all, the change from day to day is still less marked. At Mexico City the average variation from one day to another is only from a third to a fifth as great as in the northeastern United States. Such variations, except in cold weather, are one of the greatest aids to health, as appears from numerous studies of the question in New York and Boston. In Mexico, however, what few marked changes of temperature there are, probably do more harm than good, because they are so infrequent. Where people are subjected to frequent changes of temperature, they can stand a cool wave and are greatly stimulated by it. Where they live, however, in a relatively uniform climate such as that of the Mexican plateau, even a moderate drop of temperature is apt to chill them and hence to neutralize whatever beneficial effect might otherwise arise.[7]

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[7] While the day-time temperatures in the shade on the Mexican highlands vary but little from season to season, there are frequent extreme changes met with in the immediate fall of the thermometer after sundown, and in passing from sun to shade. Data published by the Observatorio Meteorológico Central at Tacubaya, just outside of Mexico Cty, show that at all seasons of the year these severe changes occur, the difference between day and night temperatures frequently amounting to 25° F. and reaching as much as 35°, while from sun to shade the difference is greater still. These variations are no doubt too frequent, sudden, and extreme to serve as a stimulus to the inhabitants, but rather expose them to constant danger of colds, thus aiding in the development of bronchitis, broncho-pneumonia, pneumonia, tuberculosis, and the diseases of the digestive apparatus, the ailments that cause most of the deaths in Mexico City. In this connection see "Climatología de la República Mexicana, desde el punto de vista higiénico," by José Guzmán, in *Memorias Soc. Científica "Antonio Alzate,"* Vol. 20, 1903, pp. 181–289.—EDIT. NOTE.

Indirect Climatic Effects

In addition to all these direct effects of climate there are certain indirect effects. One is the insects—mosquitoes, fleas, lice, ticks, and many other kinds of obnoxious vermin. Some bring malaria, typhus, and the hookworm disease; others merely cause an incessant irritation which those who have not experienced it can scarcely comprehend. Again, the Mexican diet is poor, partly because corn and beans are intrinsically a poorer diet than wheat and meat; but also because of the inertia due to other causes that prevents the people from properly varying and preparing their food. Once more, the inertia arising primarily from the climate causes the people to be slow in taking remedial measures when some minor ailment afflicts them. Thus the little troubles hang on and on, sapping the vitality and finally causing premature death.

Racial Composition of the Mexicans

Now that we have gained some appreciation of the poor conditions of health in Mexico and of the climatic causes which are responsible for them, we are ready to inquire what effect these conditions of climate and health have upon racial character. Let us preface this inquiry, however, by briefly recalling certain well known facts as to the races which make up the Mexican people. First come the Indians, a varied assortment of tribes, some with high abilities and some with low. So far as their capacities can be appraised, the Indians of certain stocks, such as the Mayas and, to a less degree, the Aztecs, are by no means to be despised. Not only do they possess the germs of greatness, but in many instances these germs have come to fruition. Nevertheless, the Indians as a whole do not seem to be endowed with minds equal to those of the more advanced races of Europe.

Over against the Indians stand the Creoles, or people of Spanish descent. So far as heredity is concerned, there is reason to think that they rank quite high. Many of the original Spanish emigrants were undoubtedly mere adventurers or worse, but the great majority were at least men with more than the ordinary degree of initiative and boldness, and a fair proportion possessed unusual ability. Thus, though the Creoles of today might be expected to inherit a certain inconstancy of temperament, they would also be expected to inherit the germs of real genius.

The union of the dull, stolid, steady Indian, with his occasional streaks of ability, and the adventurous, versatile, and inconstant Spaniard with his strong admixture of brilliancy has produced the third great element of the Mexican population, the mestizo. It is a biological law that the mixture of diverse types tends to produce extremes. This is obviously true of the mestizos. Some are completely dominated by the sluggishness of their duller Indian ancestors, while others show only the brilliant and adventuresome spirit of their best Spanish ancestors. Sometimes the good qualities of both the Spaniards and the Indians are united, and we get men like Díaz

who possessed a quick brain and a fertile imagination combined with great steadiness of purpose and strong self-control. At other times the evil qualities of both types combine, and we get stupid, cruel, and inconstant mestizos who become the worst bandits.

The Effect of Climate and Health on Mexican Character

Lack of space forbids us to analyze the effect of climate and health upon each of these three types separately, but in general what is true of one is also true of the others. To begin with the lowlands, by far the worst effect is the retardation of mental activity. Anyone who has watched his own mental processes knows that it is often difficult to think a problem through to the end; the mind revolves again and again in the same limited channels. He knows perhaps that he ought to undertake something, but it is very difficult to decide which of several things to begin and how to begin the one that is finally chosen. This lack of the power of concentration and of prompt action is one of the most marked characteristics of ill health, and ill health is the great bane of Mexico. While the people who live in a climate like that of the Mexican lowlands may not happen to be suffering from any specific disease, they practically all suffer chronically from anaemia and other unknown and unnoticed ailments which prevent energetic action. Such conditions make the inherent stupidity of the Indians more marked, while they increase the nervousness and irritability of people of Spanish blood.

Turning now to the highlands, think what it means when the best part of a country has three times as much sickness as our ordinary cities. Remember that for every death in the United States there are perhaps 300 days of severe sickness, and perhaps 6,000 days of little ailments. If our work is some dull routine process where no thought is required, the fact that we are physically below par may make little difference, but when it comes to intense and protracted thought the difference between the man who is ill and the one who is well reaches a maximum. So it is in Mexico, and the number of people whose mental work is befogged in this way is approximately three times as great as in London or New York.

Among the Indians who have been subjected to the unfavorable conditions of the plateau for an indefinite period, the more active and nervous types seem to have been largely weeded out by natural selection. Such types are apt to include the leaders who compel the rest to make progress, and their elimination is an almost irreparable loss. Among the Creoles the same tendency towards the weeding out of the more alert types is apparently going on, and the Spanish element in Mexico appears to be trending toward the relative inertia of the Indians. Nevertheless, the old nervous qualities still remain and are apparently intensified by the climatic surroundings. Hence the Creoles are excitable, unstable, and lacking in self-control. With these qualities goes an inability to apply themselves to steady work, an inability like that which we have described in the lowlands, save that it is less pro-

nounced. Yet it shows itself continually. Even among the best of the Mexicans relatively few can plan out a great piece of work in all its details and then go through the drudgery of carrying it out. Great plans, indeed, are made with ease and are proclaimed on the housetops, but the mental and physical health to carry them out is rarely present.

All these results of the Mexican environment, whether they be direct or indirect, combine to produce much of what is commonly called the racial character of the country. The fact that the body and mind are not sufficiently stimulated manifests itself in various ways according to temperament. In some persons it takes the form of ready bursts of anger; in others it leads to immorality, boastfulness, false pride, and disregard of law. Again, it seems safe to attribute to such cause a good deal of what we call the "dishonesty" of the Mexicans, and also the apparent cruelty and indifference. The Mexican sees a horse suffer from a sore on its back. He feels sorry for the animal and wants to relieve the strain, but it is too much trouble. If he had sufficient energy, he would wash the sore spot, repair the saddle, and take care of the animal's back, but instead of so doing he sits lazily around and then loads the animal next day in spite of its shrinking. Thus the Mexican becomes callous to the pain of others, and this sort of thing continued through many generations makes people indifferent to all sorts of suffering and injustice whether among animals or among men. It is well known that, in general, strong people are apt to be also gentle and considerate.

Another unpleasant trait which often strikes the foreigner in dealing with Mexicans, is their failure to think things through to the logical conclusion. Part of this failure, no doubt, is due to the innate stupidity of certain individuals and to lack of training, yet the physical and mental inertia which we are here discussing have much to do with it. Almost everyone knows that the reasoning which we do at two or three o'clock in the morning after we have lain awake most of the night, is apt to be poor. We conjure up all sorts of difficulties and cannot see them in their true proportions because we are physically depressed. In the same way the Mexican, because he is chronically below par in health, is apt not to reason things through fully. To cite the old example, he tells the weary traveler that his night's resting place is only a mile away when it is actually five. This is doubtless because he wishes to please the traveler, but if he reasoned the matter through, he would conclude that the traveler would be far better pleased in the long run if told the exact truth. His answer, in a certain way, is like the impatience of the sick man. He dces not stop to reason that he will get much more by being considerate than by being harsh.

The Relation Between Health and Character in Childhood

At this point we may well turn back once more to the Mexican mortality statistics. It is well known that the character of the great majority of

people becomes relatively fixed by the time they are twenty: many authorities say that the first five years are more important than all the rest put together. The sickly child is terribly handicapped. This being so, it may help us to understand Mexican character if we study the death rate by ages. On the basis of figures given in the official reports of the Mexican census of 1910, Wallace Thompson in his excellent book "The People of Mexico" (New York, 1921) finds that the apparent death rates for that year at various ages were as appears in column A of Table VI.

TABLE VI—COMPARISON OF MEXICAN AND NATIVE AMERICAN DEATH RATES

Age Group	A	B	C
	Death Rate in Mexico in 1910	Death Rate in the U. S. Registration Area in 1911 Among Native Whites of Native Parentage	Ratio of A to B
Under 1 year	241.0 (365.0)	102.2	2.36 (3.56)
Under 5 years	80.7 (89.5)	29.8	2.71 (3.00)
From 5 to 9 years	16.0	3.1	5.17
From 10 to 14 years		2.2	
From 15 to 19 years	12.1	3.4	3.57
From 20 to 29 years	14.4	5.0	2.88
From 30 to 44 years	19.9	6.2	3.20
* From 45 to 64 years	35.2	12.8	2.75
* From 65 years upward	97.7	64.6	1.51

* The division between the last two groups comes between 59 and 60 years in the Mexican figures.

The figures in parentheses in column A, and likewise in column C, probably ought to be substituted for the others. The reason for this appears in Table VII, which is inserted partly to show how difficult it is to deal with Mexican statistics. The two columns of figures in Table VII show the number of persons of various ages in a Mexican population of 15,160,369 and in a standard or typical population of 15,445,608 in the northern United

TABLE VII—CHILDREN OF VARIOUS AGES AMONG MEXICANS AND IN A TYPICAL POPULATION OF SIMILAR SIZE IN THE UNITED STATES, 1910

Age Group	Mexicans	Americans
Under 1 month	60,172	24,180
1–6 months	205,049	116,586
6–12 months	512,417	134,793
Under 1 year	777,638	275,559
1–2 years	467,943	261,285
2–3 years	467,977	256,587
3–4 years	461,849	254,049
4–5 years	457,761	252,348

States in 1910. The much greater proportion of children among the Mexicans means not only that the birth rate in Mexico is high but that relatively few people live beyond middle age.

For our present purpose the important feature is that the number of infants from 6 to 12 months of age in Mexico in 1910 according to the official figures was nearly twice as great as the number under 6 months of age—512,417 against 265,221—whereas the corresponding figures for the United States are 134,793 and 140,766. This is, of course, absurd, for in times of peace and relative prosperity the number of children born in two successive periods of six months never differs by more than a few per cent. Probably the number 512,417 is the total of all children under a year in age. This would leave 247,196 from 6 to 12 months of age. Or possibly, though less probably, the number 512,417 should be 212,417. Either supposition makes the Mexican figures in Table VII consistent with one another and with those of the United States, for it removes the impossible excess of children in the lines labelled "6–12 months" and "Under 1 year." The corrected numbers in parentheses in Table VI are based on the supposition that 512,417 is the number of children under 1 year of age. Such corrections emphasize the fact that Mexican statistics are not only carelessly collected but heedlessly tabulated.

The High Infant Mortality

Turning back to Table VI, column B shows the death rate per 1,000 during 1911 among about 24,000,000 native whites of native parentage in the registration area of the United States with the omission of the three most southerly states, North Carolina, Maryland, Kentucky. Only one year is used; but it was a typical year, and the basis of population is so large that more years would not appreciably affect our results. For Mexico no other years are available. Column C in Table VI gives the number of times by which the Mexican rate exceeds the native white rate in this country. At the ages of 5–9 and 15–19 respectively the Mexican death rate is 5.17 and 3.57 times as great as among the native white Americans. Among older people this excess gradually, though irregularly, diminishes. The great falling off among old people is probably because their deaths are recorded less carefully than those in the prime of life. Moreover, the age of old people is frequently overstated. For example, while Mexico purports to have about one-fifth as many people aged 70 as have the native American whites in proportion to their numbers, she claims over four times as great a proportion over 100 years of age.

Among young children, as well as among old people, the ratios in column C of Table VI appear to be less than at the ages of 5–14, but this is almost certainly fictitious. All backward countries show the same tendency toward carelessness in recording the deaths of old people and still more of children, especially very young infants. It is well known that in advanced countries

the greatest medical progress has been made in the reduction of infant mortality, whereas backward countries have done little along this line. Hence there seems little doubt that the ratios in column C of Table VI should be larger in infancy and early childhood than at any other time. Accordingly it seems safe to estimate the ratio for infants under 1 year in column C as 6.0 or even 7.0 and for children under 5 years as 5.5 to 6.0 or possibly more.

Even these estimates, however, are below the truth. They are based on an annual death rate of 30.8 for Mexico as a whole; but this is calculated from figures collected by unskilled and careless census agents. When it is remembered that even in the United States no reliable mortality figures are available for nearly half our area, there will be no surprise if Mexico's actual death rate should prove to be a third larger than is reported. Even that, however, would make it less than the reported rate for Mexico City. All things considered, then, it seems probable that among Mexican children under 15 years of age the death rate is from 5 to 8 times as great as among native white children of native parentage in the northern United States. On an average, however, even such American children suffer more from illness than do those of the more intelligent tenth from whom are drawn the readers of this article. Hence the death rate among average Mexican children is probably 6 to 9 times as great as among the relatives and friends of the reader. If that is so, it would seem as if Mexican children must suffer from illness 4 to 6 times as much as do the children of our own most intelligent communities. How great an effect this may have upon character, I have tried to show in the article referred to on page 243. Almost certainly it must mean that inherited weaknesses of racial origin are intensified. If the Spaniards as a race are lacking in persistence, or if they are not gifted with great self-control, these qualities are sure to be exaggerated if the childhood is sickly. If the Indians are stolid and stupid, repeated periods of ill health in childhood will certainly not help to overcome these traits.

In all this discussion of the effect of climate upon health, and upon character, it must be recognized that many causes are working together. Hence it is almost impossible to distinguish between things that a man does because he is stupid, those that are the result of bad training, and those that occur because his health is poor. In this article we are merely pointing out ways in which the general enervation produced by the climate of Mexico tends to increase tendencies which may exist for other reasons. If the Mexicans were all of high mental caliber—if, for instance, they were equal to the Puritans who settled in New England—doubtless their lot would be much improved. If they were properly educated and trained, there would also be improvement. All the disadvantages of the country work in a vicious circle, each accentuating the other. What Mexico needs from foreigners is first an appreciation of the many fine qualities which are still innate in all parts of her population; second, a realization of the way in which these good traits are often smothered by sheer lack of energy and will power because of

a great variety of unfavorable conditions of physical environment and health; and third, a sympathetic comprehension of the steps by which the forces of historic development have interplayed with heredity and environment to produce the present tangled web. Without help from outside or without some rare inherent capacities it is doubtful whether any race could successfully resist the unstimulating and discouraging effects of the Mexican physical environment. Yet if we can discover just how the environment acts to produce its depressing effects and can then pass on our knowledge and help in its application, there is little doubt that a large part of the climatic handicap can some day be overcome.

RECENT HISTORY AND PRESENT STATUS OF THE VINLAND PROBLEM

By W. H. Babcock

It is now eight years since the author published the results of his researches into the matter of Vinland.[1] He here proposes to analyze the subsequent developments in comment and theory of this three-century-old problem, whose solution is still incomplete.

In "Early Norse Visits to North America" it was urged, as had been urged previously by Dr. Storm and others, that among Vinland saga texts our reliance should be mainly on the eldest—the Hauk's Book narrative and the nearly identical, though independently copied, manuscript No. 557 of the Arna-Magnaean collection at Copenhagen, entitled "Eric the Red," and that the Flatey Book version should be used only incidentally and with special caution. It was further stressed that in geographic identification we must distinguish the names of extensive regions (usually ending in "land") from those which mark some notable local feature of the coast line and that in dealing with both, and especially in dealing with the latter, we have to consider and compare the coast of about the year 1000, which is not necessarily the same as that of today. The final conclusion was that allowing, however imperfectly, for these transformations and for the natural failure in exactness of a popular story growth which remained unwritten for about two hundred years, we may still say that Karlsefni's main quarters in Vinland (Straumfiord) were most likely at Passamaquoddy Bay, with Grand Manan Island (Straumey) out before it in the currents at the mouth of the Bay of Fundy; and that Hóp, the most southerly point which he attained, was almost certainly in lower New England, perhaps (though not necessarily) at Mount Hope Bay (see Fig. 1, p. 267.)

Some of the foregoing suggestions—especially as to coastal changes and the difference between a "land" and a spot—would seem almost too rudimentary and obvious for statement, except for the fact that they are so perversely disregarded by really notable writers.

Hovgaard's Work

In 1914 appeared an important book, "The Voyages of the Norsemen to America,"[2] by Professor William Hovgaard, an acknowledged authority on nautical architecture and engineering and on navigation, also exceptionally versed in Scandinavian matters. Its preliminary presentation of

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[1] W. H. Babcock: Early Norse Visits to North America, *Smithsonian Misc. Colls.*, Vol. 59, No. 19, Washington, D. C., 1913.

[2] William Hovgaard: The Voyages of the Norsemen to America (Scandinavian Monographs, Vol. 1), New York, 1914.

the lives, homes, and relics of old-time Icelanders and Greenlanders is particularly interesting. His account of the means and methods of Norse navigation is a worthy companion to Dr. Nansen's treatment[3] of the same subject, which was published while Professor Hovgaard's book was in preparation. Thus we have two independent mutually supplementing and perhaps equally valuable dissertations by experts on the problem from "the point of view of the navigator"—a quite vital one. Taken together their attractive and helpful presentations seem to have exhausted that branch of the subject.

Hovgaard's Use of Illustration

There is another feature of the work on which Professor Hovgaard seems to lay especial stress and which has a certain interest and value. He calls attention to the lack in Dr. Nansen's volumes of "any description or illustrations of the coasts of America likely to have been visited by the Norsemen" and himself provides a series of photographic views taken at intervals all the way from Baffin Land to New Jersey. Necessarily they leave many points unshown, but they present a more nearly complete exhibition of the kind than has hitherto been attempted. Obviously, it is confined to the sea front as it appears now. Probably some parts of the coast have changed little in aspect since Thorfinn Karlsefni's time, and for purposes of comparison with the words of the sagas the illustrations are strictly relevant; but such is not always the case.

Testimony as to Transforming Changes

Professor Hovgaard incidentally bears significant testimony to transforming changes.

> A characteristic feature of Labrador, and, as mentioned above, of Baffin Land also, is the deposit of drifted boulders with which the surface of the country is thickly strewn, left on the bed rock by the ice of the glacial period. The presence of these boulders is especially marked on the higher levels; in fact, near the coast below the two-hundred-and-fifty-foot level they have been largely washed away or ground down by the sea during the process of uplift of the land which took place in post glacial times. Many boulders are left stranded in the valleys of the emerging land on the so-called raised boulder beaches. These boulders remind us of the *hellur* of the sagas, that is the rocks, or large (flat) stones, which suggested to the Norsemen the name "Helluland."[4]

The passage which Professor Hovgaard has chiefly in mind is no doubt that from Hauk's Book, rendered by him as follows:

> They sailed first to the Western Settlement and from there to Bjarneyar (Bear Islands). Thence they bore away southward two days . . . , when they saw land and put out the boat and explored the land and found there large flat stones, many of which were twelve ells wide. . . There were many Arctic foxes there. They called the land Helluland.[5]

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[3] Fridtjof Nansen: In Northern Mists, translated by A. G. Chater, 2 vols., New York, 1911.

[4] Hovgaard, *op. cit.*, pp. 194–195.

[5] *Ibid.*, p. 103.

The parallel but slightly more archaic manuscript, A.M. 557, has "with a north wind" instead of "southward" and defines the width of the stones by the statement "two men could spurn soles" on one of them, obviously lying at length. *Hellur*, meaning flagstones, would not perfectly fit ordinary boulders; but the Norsemen may have named by analogy rather than by strict identity, as we all often do. Now an illustration of Thorfinn Karlsefni's landing might or might not show a "boulder beach" at water level, for the text does not absolutely require this, but it would be quite likely to present a foreground considerably different from anything that we can see now. Of course, nothing which was then under water can help in identification. The Ragged Islands that figure conpicuously in one of his views are a probable case in point. Professor Hovgaard elsewhere ascribes a similar and still continuing uplift to Newfoundland. However, it may be granted that there has been less transformation of abrupt coasts like those of parts of Newfoundland. It would seem that a cliff may usually be raised or lowered a few feet or a few score feet without greatly changing the aspect of its wave-washed base. As will be mentioned later, more important modifications in appearance and productiveness may have taken place on more southerly parts of the North American coast as the result of submergence.

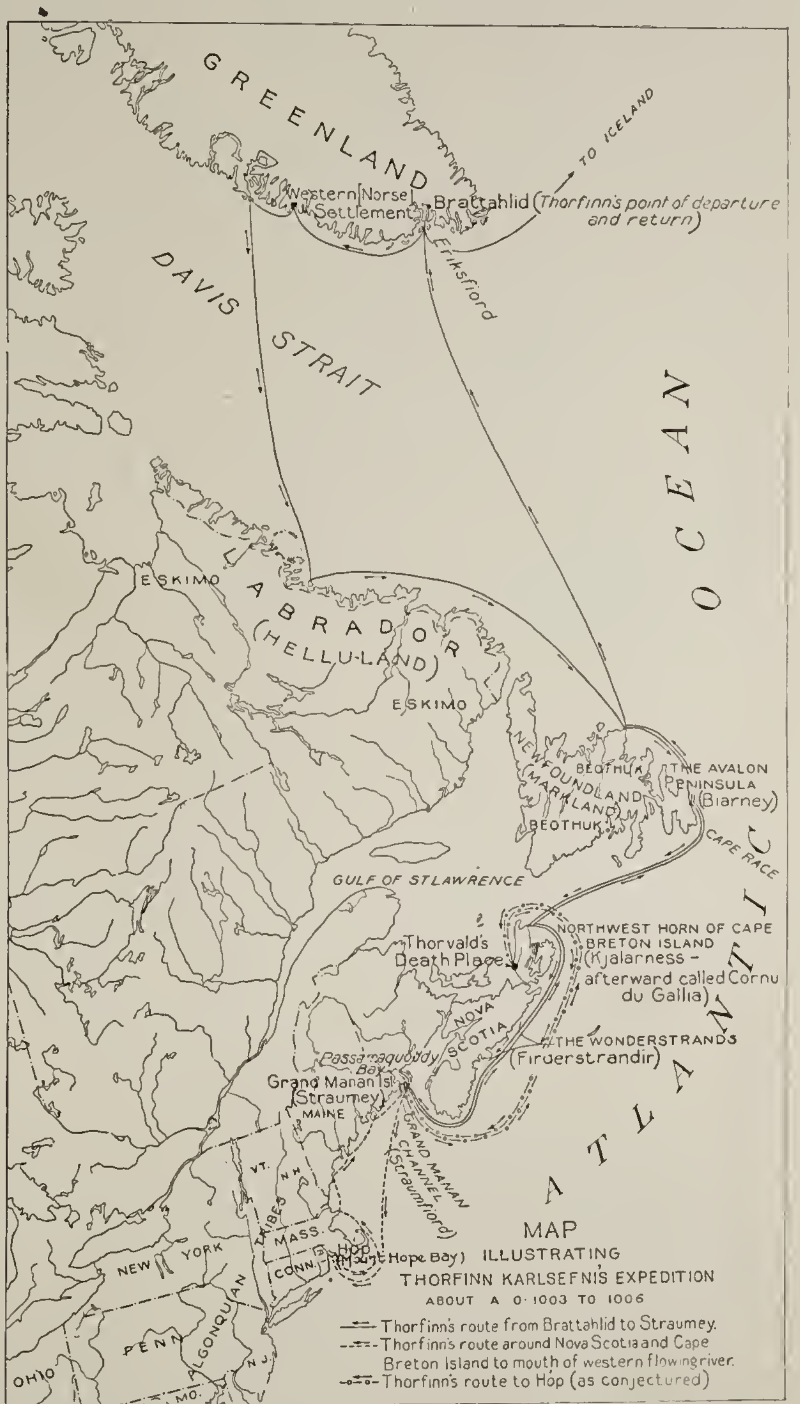

FIG. 1—Map illustrating the Vinland Problem reproduced on a reduced scale from map accompanying the author's work, "Early Norse Visits to North America."

A Confusion of Saga Geography

A salient feature of the book is a conjectural duplication or triplication of saga geography. We are told that Leif's Vinland may be distinct from anything visited by Karlsefni and that "the Markland of one expedition may have been the Vinland of another, and the Helluland of one expedition may not have been the Helluland of another."[6] This curious way of looking at things reaches almost perversity in such a statement as: "If Markland was at Cape Porcupine, we must seek Vinland (i.e. Leifsbooths) farther down."[7] True, Professor Hovgaard is here dealing with the local identification of another; but these passages reveal a too narrow tendency to treat a great region as a particular place. He would never dream of restricting old-time Iceland to Skalholt or old-time Greenland to Gardar; but he has a strong tendency to identify Vinland with Leifsbooths or Hóp or some other restricted neighborhood; and his objection to Cape Porcupine for Markland is not that it is a cape, a mere spot instead of a land, but that it is the wrong cape or spot.

He recognizes, however, that the relative positions of the three American lands are always the same in the sagas: "Markland was in a lower latitude than Helluland, and Vinland was in a still lower latitude than Markland."[8] In this they reflected reality. The American sea front presented first the region of treeless, stony northern wastes; then, going southward, the forest country, still cold during many months and not bountiful in natural yield except of timber and game; and lastly the warm and fertile land of vines producing abundant grapes and that wild grain which in its young growth looked like wheat, though it was really wild rice, and which the Norsemen called self-sown wheat by analogy, being amply familiar with wheat, raisins, and wine by reason of their European trade.

Efforts to Harmonize Hauk's Book and the Flatey Book

Professor Hovgaard is not at all content with Dr. Storm's arraignment of the Flatey Book narrative as a late corruption of the Hauk's Book saga distinguished by numerous errors quite out of accord with seasons and conditions in the new world and of a kind least likely to be made by a contemporary. He is at some pains to harmonize the two versions almost *vi et armis* even where they are apparently in conflict—an amiable and helpful intent if it were feasible. The results are sometimes curious. Thus he ascribes two American voyages to Leif, although neither version nor any tradition is aware of more than one; but two are required to provide for inconsistent events, motives, and details. The credit of first discovery is given to Biarni instead of Leif, to save the former's voyage for the Flatey Book, but the credit of the latter is not stalwart enough to carry the voyage

[6] *Ibid.*, p. 221.
[7] *Ibid.*, p. 225.
[8] *Ibid.*, p. 221.

story of Leif's half sister Freydis and her ghastly inhumanities, which he supposes, agreeing with most others, to be developed unwarrantably from some grotesque but harmless hints in Hauk's Book. The inconvenient accounts of southern conditions and products at Hóp—which he considers much more northern—are explained as transfers from a supposed narrative of Leif's explorations, now lost to us.

According to Professor Hovgaard's calculation, Biarni struck by accident on the Newfoundland coast, made his second landing at Hamilton Inlet, Labrador, and his third probably at an island off Baffin Land, whence he sailed to his father's Greenland home. Leif, having in a previous voyage struck on the lower coast, reversed Biarni's route, continued it along the sea front of Newfoundland and Nova Scotia to Cape Sable, "Leif's Markland," then crossed the Gulf of Maine to southern New England. He says: "Leif's Vinland was in the region of Cape Cod."[9] Leif may well have been there, but the data are too meager for confident assertion. No doubt he reached some seaboard where warmth prevailed and grapes fit for wine making abounded. Beyond that we can neither affirm nor deny. But the conception of Vinland among the old Norsemen apparently would include Cape Cod.

Schedule of Karlsefni's Voyage

The Hovgaard map of Karlsefni's voyage places his first landing on the extreme northern part of the Labrador coast; his second (supposed to be in Markland) less defensibly on the same coast a little below Nain, near the northern limit of even rather small trees, where perhaps no one ever thought of finding a forest before; his third, Straumfiord, their chief Vinland home, on Sandwich Bay also in Labrador, moderately available as a rather cold oasis but in the immediate neighborhood of the shore aptly described by Cartwright as "the country God gave to Cain;" and, finally, his most southern point, Hóp the delightful, at or near Sop's Arm on the particularly inhospitable front of northern Newfoundland. In view of the many fine and valuable things which the book contains, such a schedule must be found disappointing. In the saga the whole region near Straumfiord is presented as attractive during summer time.

> There were mountains there, and the country roundabout was fair to look upon. They did naught but explore the country. There was tall grass there.

Of Hóp it is written:

> There were self-sown wheat fields on the land there wherever there were hollows and wherever there was hilly ground there were vines. . . . They remained there that winter. No snow came, and all of their live stock lived by grazing.[10]

Perhaps "no snow" is to be understood as no snow that would lie deep and interfere with grazing. There might be very little snowfall, indeed, during

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[9] *Ibid.*, p. 228
[10] *Ibid.*, p. 107

an unusually mild winter at Narragansett Bay. But it cannot be pretended that the winter conditions recited fit Newfoundland. The only recourse is to discard such passages; but they are integral, characteristic, and significant parts of the saga, and there is no trace of interpolation.

Fossum's Work

More recent and a little less full is Dr. Fossum's discussion of the Norse discovery of America. The following sentence from the introduction gives the spirit of his treatment: "If this work has any character of its own, it is that it accepts without reserve the statements of the saga narrative and attempts to follow the text closely."[11]

Origin and Character of the Saga

This is going much too far in the other direction. Such acceptance might be warranted if we had in hand authenticated contemporary narrations of the normal historic kind; but no one pretends that the explorers brought a saga back with them or even wrote one afterward. There may have been written memoranda in the nature of a ship's log, though the prevailing opinion is that even these items passed by oral tradition only. For the rest the Vinland-voyage parts of the most nearly trustworthy version that we have are chiefly of ballad-like verses translated into prose and presenting successive episodes in a graphic, imaginative, sometimes mythical, way. As I have suggested in "Early Norse Visits:" "A not extravagant ingenuity may distinguish the episodes of Thorhall the Huntsman, the Gaelic Runners, the Battle at Hóp, the Death of Thorvald, the Markland Captives, and the Death of Biarni, each easily separable and individual, as probably single ballads in their original shape."[12] Two of them preserve residua of the original verses, which by diction and meter are said to belong to the eleventh century.

The more voluminous earlier portion of the saga, dealing with events in Iceland and Greenland, and especially the latter, is developed from, or built up about, the achievements of Eric the Red and in a lesser degree the experiences of Gudrid, the wife of Thorstein Ericsson and afterward of the more successful explorer, Thorfinn Karlsefni. It is picturesque with elaborate sorceries, gruesome prophecies by a supposedly reanimated corpse, and sufferings from threatened shipwreck, famine, and pestilence.

These varied materials were brought together, through what intermediate procedure we cannot tell, and took shape in the final saga-composer's hands about the year 1200, to judge by the nobly epic style which is characteristic of that period. There may have been some changes between that time and its final copying into Hauk's Book a few years before the death of Hauk Erlendsson in 1334. It is certain there were some divergencies in different

[11] Andrew Fossum: The Norse Discovery of America, Minneapolis, Minn., 1918, p. 8.

[12] Babcock, *op. cit.*, p. 79.

copies, for the parallel and corroborative manuscript A.M. 557 varies slightly at several points and omits the final genealogy, which Hauk himself apparently added. Even at the first there was some uncertainty; the saga itself frankly gives us an alternative variant of the Hóp expedition, making Karlsefni take but a part of his force with him, leave Biarni and Gudrid behind at Straumfiord, and return after only two months' stay. There are signs, too, that the saga man permitted himself occasional liberties with his material. Thus Haki and Haekia as the matter stands are said to find grapes and grain in spring, that is, about the time that the eggs of sea birds and waterfowl were plentiful. Their little story does not synchronize with the rest of the saga. There can be no doubt that we have here a real instance of displacement. Whether for Thorfinn or for Leif before him, these Gaelic Runners did their rapid investigating, if at all, in the early autumn.

However much we may value this saga for its general evidence of an important feature of history and for its high and entertaining literary qualities, can we reasonably treat it as a sacred gospel to be followed "without reserve" and "closely" in all its "statements"?

Origin and Character of the Flatey Book Narrative

The case for the Flatey Book narrative is much worse. We have no history of it before its copying in 1385; but good judges hold that its composition cannot have been much earlier, determining by the test of style, which is crucial in these Icelandic matters. That is it became a saga about 350 or 375 years after the Vinland voyages. The saga composer had knowledge of some version of the Hauk's Book narrative, for he refers to the Saga of Eric and in another place mentions Karlsefni as having given the fullest account of Vinland matters. He must also have had access to other traditional sources for items which seem authentic, such as the palisades around Thorfinn's house, the grain shed on an island, and the crude astronomical observation of the length of the day and the sun's rising and setting, presumably made at Straumfiord. But he has confused this bay with Hóp; has multiplied voyages, making almost every prominent person of Thorfinn's party head one of them; and has generally blurred the record. Leifsbooths, of which the other saga knows nothing and which Leif can hardly have had time to build in the Vinland interruption of his main mission, are found by each succeeding party of explorers apparently intact (for there is no suggestion of rebuilding) even after the natives had shown themselves furiously hostile and would surely have visited destruction on anything belonging to the invaders. Inconsistencies and errors abound.

Nevertheless, Dr. Fossum prefers the Flatey Book version in most cases where the two differ, although, like Professor Hovgaard, he aims to utilize both. Here is his statement of the case.

The two sagas that relate these exploits each presents [sic] a distinct phase of the events. The story of the Flateyarbok gives an account of the deeds of the family of Eirik the Red

and the Greenlanders. The story of the Karlsefne saga describes in detail the expedition of Karlsefne and the Icelanders. Karlsefne was an Icelander, resided in Iceland, and was there looked upon as a national hero. As long as it was possible to keep apart the stories of the Greenlanders and the Icelanders, there was no quarrel between the two sagas; but as soon as the geography of the new discoveries became confused and indistinct, the claims of the Greenlanders and Icelanders are sure to clash. . . The saga of Bjarne, Leif, and Thorvald developed in Greenland . . . and was late in coming to Iceland. . . The saga of Eirik the Red and his family in Greenland and the saga of Karlsefne in Iceland seem to have developed independently for at least two centuries. When at length they attempted to combine them they found that the only part that suited both was the account of Eirik the Red in Greenland. . . Counter-claims were made by the partisans of the two families, and a strife arose which has continued down to our day. . . In how far [sic] Karlsefne himself is guilty of misrepresenting the facts, and how much we are to attribute to his ambitious family, is not easy to determine. . . At any rate they made claims which Leif's friends in Greenland could not concede. . . In thinly veiled language they attacked even Eirik the Red, who had helped them in many ways and shown them great hospitality in Greenland.[13]

Objection to Fossum's Conclusion

The total offending on which is based the charge of "ingratitude for his hospitality" seems to be that in the artless graphic fashion of such narratives, often concerned about trifles, the saga in Hauk's Book relates how Thorfinn Karlsefni from his ship stores helped out Eric's supplies at Christmas in a time of dearth, so that all enjoyed themselves mightily. This was probably true, having regard to the conditions of the time and place. The statement seems natural and harmless. One must demur to other features of these and like passages. We do not know that there was any saga of "Biarni, Leif, and Thorvald" nor that any saga ever was composed in Greenland. Biarni was not a member of "the family." The Greenland passages of the two sagas are far from identical. There is no Karlsefni saga authoritatively so named from the beginning. Centuries after the copying of Hauk's Book, Arne Magnusson found its version left without title and wrote into the blank space above it: "The Saga of Thorfinn Karlsefni and Snorri Thorbrandson," but it is generally believed that the title should be "The Saga of Erik the Red" as in the case of the companion manuscript A.M. 557. There is no proof of any strife between Icelanders and Greenlanders over claims to glorification in or by these sagas. The Erik the Red saga of Hauk's Book and its companion does not appear to have been conceived at all in a spirit of hostility to that chieftain and his family or disparagement of them.

It is very far from being a eulogy of Karlsefni or Icelanders generally at the expense of Eric's family or of Greenlanders, and it is not the narrative of an exclusively Icelandic voyage, as thus contradistinguished; though, as to that, all Greenlanders were then Icelanders of less than twenty years' residence in Greenland. It certainly presents Thorfinn Karlsefni's claims to distinction, but he was almost a member of Eric's household circle and at any rate had rendered a conspicuously important service which could not be suppressed.

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[13] Fossum, *op. cit.*, pp. 134, 135, 137, 147–148.

A more plausible indictment for injustice to the family of Eric might be drawn against the Flatey Book version, which deprives Leif of the credit of first discovery in favor of the outsider Biarni and charges Freydis with most diabolical murders, including the unprovoked slaughter of several quite helpless women by her own hand. However, there is no need to impute any sinister motive or unfair bias to the composer of either form of the saga. The pleasure of telling a good story and explaining historical matters would no doubt be motive enough. This article has already indicated how these narratives probably came into their present volume and shape.

Fossum's Location of Vinland on the St. Lawrence

As a result of his study of the sagas, in particular of their sailing directions, real or fancied, and with some personal inspection of the ground, Dr. Fossum dissents widely from some parts of Professor Hovgaard's scheme of courses and landings. In the case of Karlsefni the comparison is not startling. Dr. Fossum merely shifts Straumfiord from Sandwich Bay, Labrador, to Notre Dame Bay, Newfoundland, and Hóp from one Newfoundland bay to another a little more southward, without making the identification appreciably more acceptable. But the treatment of Leif is quite revolutionary. Instead of carrying him to Cape Cod and warm regions beyond it with Professor Hovgaard, Dr. Fossum takes him through the strait of Belle Isle and the Gulf of St. Lawrence westward to the island of Anticosti and the mouth of the St. Lawrence River, then up the river as far as the northern limit of growth of the large wild grape at the Isle of Orleans. In other words, his Vinland is not on the seaboard in relatively warm latitudes but inland westward up and down that northern river, where winter is winter indeed. It follows that Thorvald's western boat voyage is exclusively a river journey and his eastern voyage becomes a nearly complete circumnavigation of the gulf. But the settlement of Leifsbooths, the alleged chief home in Vinland, is placed on the St. Lawrence River, and there's not much about it all to suggest the old geographers' conception of a possible connection with Africa.

Considering that both Professor Hovgaard and Dr. Fossum rely chiefly on the Flatey Book for all events preceding the voyage of Thorfinn Karlsefni, that their methods are much alike, and that both are especially equipped for the task, it seems curious and suggestive that such diverse results should be reached.

A brief inspection of some of these Flatey Book guideposts may be instructive. It is related of Leif's party:

> When they were ready they sailed out to sea and found first the land which Biarni and his shipmates found last. Great ice mountains lay inland back from the sea. . . They returned to the ship, put out to sea, and found a second land. . . They sailed away from the mainland with northeast winds and were out two days before they sighted land.

These vague assertions appear to have been strung together to continue the story, without an attempt at such precision as would guide future navigators or permit close identification of places. Some other statements are perhaps a shade more particular, but it is manifestly unsafe to treat them as invariably significant, exact, and reliable and to strain for the utmost that can be evolved from them. Such a procedure might land us in any harbor.

The Testimony of the Cross

In support of his Vinland by the St. Lawrence Dr. Fossum cites instances of early missionaries who found the cross in that region, with some accompanying vestiges of Christianity. We cannot tell how far the wish may have been father to the thought in the case of these good priests. The cross is a rather widely spread symbol. But if it and other religious relics of any kind really were left by white visitors there is still no occasion for crediting the gift to the Norsemen, especially since they at the opening of the eleventh century were newly and imperfectly Christianized at the best. But other white peoples with a more deeply grounded Christianity may well have been on the St. Lawrence long before the time when the cross surprised the priests. The map of Sylvanus, 1511, shows the Gulf pretty accurately and affords a fair indication that some one had explored it. Basque and Breton fishing crews frequented the banks of Newfoundland and the neighboring shores still earlier and may have sailed far within. It is needless to prolong the list of possibilities. There is nothing at all to connect these supposed vestiges of Christian faith with the Norsemen.

The Testimony of the Game Lacrosse

As further reinforcement Dr. Fossum cites the game of lacrosse, which has already done similar duty in several works. But those who know the Indian best seem convinced that it is of exclusively native origin. Any partial parallels of Norwegian origin may well pass as coincidences or as being conceivably due to some vastly remoter common ancestry—the former being much more likely. But even if the Norsemen taught lacrosse to some Indian tribe the performance may have taken place at any one of many points along the coast. There is nothing to anchor it to Gaspé, Anticosti, or the Isle of Orleans. Surely the case for corroboration is as wavering and tenuous as heat haze in summer time. The St. Lawrence hypothesis is not new with Dr. Fossum. Indeed, as applied to Great Ireland, it is at least as old as Eugène Beauvois' work[14] on the discovery of the New World by the Irish; that is to say, the seventies of the last century. Though never widely accepted and though discountenanced by facts and climatic conditions, this theory comes into sight now and then with a new advocate.

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[14] Eugène Beauvois: Le découverté du nouveau monde par les irlandais, Nancy, 1875; map on p. 82.

Fossum's Real Contribution to the Subject

One can only say that Dr. Fossum has been more happy in some less salient and capital contentions. He has made it seem even more probable than before that Eric the Red extended his first explorations to a part of Baffin Land. He may be right also in supposing that the Bear Islands, from which Karlsefni took off more or less to the southward on his voyage to Helluland, lay on or near the Baffin Land shore—Upper Greenland or Baffin Land, it matters little which. A northerly wind such as is mentioned in the saga would facilitate the voyage from either point, with a difference of only a few degrees in the direction of sailing. It may, however, be as well to adhere to the still general understanding till we have more conclusive evidence that this point of departure was on the western, not the eastern, side of Davis Strait.

Steensby's Views and Gagnon's Criticism

Mr. Alphonse Gagnon, of Quebec, thoroughly conversant with the productions and temperature of that region, has had a word to say concerning the hypothesis which locates Vinland there.[15] It is in reply to a study by the learned Danish ethnographer-geographer, Professor Steensby, unhappily since deceased, on "The Norsemen's Route from Greenland to Wineland,"[16] which with local differences follows the same general lines as Dr. Fossum's work. Mr. Gagnon expresses grave doubt that the Norsemen would find wild grapes in the territory now comprised in the county of Montmagny, at least in such quantity and quality as would justify the name Vinland. He finds other incongruities in the saga statements that the cattle lived freely at pasture in winter time and that the ground was not frozen.

Steensby takes Karlsefni as well as Leif up the St. Lawrence and finds Keelness near the mouth of the Saguenay, instead of on the Newfoundland shore, while Straumfiord becomes a reach of the lower St. Lawrence River, Straumey the Small Hare Island therein, Hóp a slight expansion of the Rivière du Sud a little above its mouth near St. Thomas, and Wineland the southern shore of the main river and the country behind roughly corresponding to the county of Montmagny or in a wider sense the whole lower part of the valley of the St. Lawrence River. This is more thoroughgoing than Dr. Fossum's scheme of the voyages and offers a welcome relief from the contrasting references to "Leif's Vinland" and "Karlsefni's Vinland" in some recent works. But the Danish writer appears to attain unity and conformity by establishing both of them in inadmissible quarters, condemned by considerations of climate and natural production such as Gagnon has indicated. However there is, of course, much of solid worth in Professor

[15] Alphonse Gagnon: La question du Vinland, *Bull. Soc. de Géogr. de Québec*, Vol. 12, 1918, pp. 211–218.

[16] H. P. Steensby: Norsemen's Route from Greenland to Wineland, *Meddelelser om Grønland*, Vol. 56, Copenhagen, 1918, pp. 149–202.

Steensby's little treatise. It insists on Dr. Storm's position in favor of the Eric the Red saga as given by Hauk's Book and A.M. 557 and the comparative unreliability of the Flatey Book version.

Vignaud's Position

The veteran historical investigator Henry Vignaud has published an interesting review[17] of my "Early Norse Visits to North America." It comprises a very fair summary of much of the contents of that book and presents many remarks with which I am in accord. However, Mr. Vignaud does not think we are warranted in seeking lands of Norse discovery so far south as southern New England. He believes that if these redoubtable people had discovered a country so lovely and fertile as that where they have placed their station of Hóp they would have remained there, notwithstanding the admittedly dangerous hostility of the Indians. But we must not accept unreservedly the nearly impossible feats of arms recorded in the Icelandic sagas. These Norsemen were good soldiers but not magicians. Also there were few of them, while the Indians were relatively very numerous. Thorfinn Karlsefni's Vinland expedition, the largest on record, numbered only a hundred and sixty men. On the other hand, the region about Narragansett Bay was probably abundantly populated by natives, as it was when white men next found the place. The Norsemen, of course, had no firearms and were little, if any, better supplied with missile weapons than their opponents. Their principal advantage was in the possession of steel swords and axes as contrasted with the stone tomahawks of the Indians; then, too, their shields protected them. There is also something to be said for their wider, if still credulous, intelligence and their better disciplined ways. But all these advantages could not offset such great odds nor sufficiently fortify them against the wearing, unhopeful discomfort of living constantly on guard against a relentless and stealthy enemy. Some of the early English settlements, better equipped than the Norse, failed utterly; others maintained their ground with difficulty by the aid of repeated reinforcements from an ample home population in times of readier transit. The Greenlanders and Icelanders in Vinland were practically cut off from their bases, and, even had these been accessible, few men could have been spared from Greenland. It seems that Karlsefni consulted only common prudence in withdrawing from an untenable outpost while his force was not yet weakened. The final abandonment of Vinland was determined, according to the saga, by fierce quarrels at Straumfiord among the colonists themselves over the women; also perhaps in some degree by the unsatisfactory winter conditions of the place. It all seems to follow very naturally and quite in the order of things, human nature, savage and quasi civilized, being as history discloses.

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[17] *Journ. Soc. des Américanistes de Paris,* Vol. 11, 1914, No. 1, pp. 335–337.

Delabarre's Summing up of Recent Opinion

Professor Delabarre, while dealing amply and excellently with a quite distinct theme,[18] has incidentally reviewed the recent course of opinion as to the problems of the Vinland voyages, taking a kind of straw vote of the authors represented in his notes and observing changes of judgment from time to time. He disclaims positive conclusions of his own, for reasons given; but his brief summary presents very favorably the work and views of Dr. Fossum, who "seems to establish conclusively the fact that Leif's Vinland and Thorfinn's Hóp were different regions."[19] As already set forth, one cannot recognize Hóp as a "region" at all nor admit that Vinland was a region which did not include Hóp.

The Bearing of the Dighton Rock Inscription

Professor Delabarre relates some interesting observations which he has made bearing on the subsidence or non-subsidence of land in the neighborhood of Dighton Rock,[20] consequently in all probability about Narragansett and Mount Hope bays as well. He is doubtless right in attaching importance to the marsh-growth investigations of Mr. Charles A. Davis, tending to establish depression of the New England coast even considerably farther north. His own experiences with Indian artifacts on an old level below the marsh-peat surface of an island near the rock have a like tendency. Regarding the surface on which the rock has stood the evidence of certain colonial entries suggests movement in the opposite direction so far as concerns the last two or three centuries. But these entries, as cited, seem indefinite with regard to the area now under water. In any case, it is not necessary to maintain a subsidence of the coast continuing till the present time nor till those entries were made. It is hardly reasonable to suppose that a part of the Dighton Rock inscription was carved under water or in immediate expectation of overflow, such as regularly happens now. The year 1003 is a long way off and allows leeway for considerable changes. One need only suppose a moderate lowering of level—regular or irregular, continuous or discontinuous—during some part of the last nine hundred years. Wild rice is still native to the Narragansett region; we picture ample beds of it in the time of Karlsefni, the wild "wheat" in "hollows" of the saga, where now is only water. It is not likely that one neighborhood is an exception to the general behavior of the lower coast, easily accounted for by the post-glacial uplift of the shore farther north.[21]

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[18] E. B. Delabarre: Recent History of Dighton Rock, *Publs. Colonial Soc. of Massachusetts*, Vol. 20, Boston, 1920, pp. 286–462; reference on pp. 315–317.

[19] *Ibid.*, p. 318.

[20] *Ibid.*, pp. 399 and 400.

[21] The generally accepted theory of recent and continuing subsidence of the Atlantic coast of the United States and the southeastern coast of Canada has been controverted by Professor D. W. Johnson who sets forth the theory of coastal stability within historic times. See the article "Is the Atlantic Coast Sinking?," *Geogr. Rev.*, Vol. 3, 1917, pp. 135–139.

Conclusions

It will be observed from the foregoing summary of the work of recent writers that there is a considerable tendency to rehabilitate the Flatey Book narrative as an authority or source; to partly harmonize the two versions by making them deal with expeditions to distinct regions, by multiplying Vinlands, and the rest; and to disregard the saga's explicit statements of the favorable conditions of Hóp and to locate that bay at one point or another of the chill face of Newfoundland. By some writers Leif's Vinland fares better, being allowed to stray even as far as southern Massachusetts; but by others it is held fast to the shores of the St. Lawrence. A minutely literal method of construing these old half historical voyage stories, to which we have all perhaps been too much addicted, has now about reached its climax. To say that the foregoing features of criticism and exposition prevail for the present is not, of course, to admit that they are mainly sound or correct. Not very long ago Nansen's mythological criticism was in the ascendant, threatening to obliterate the saga altogether. That phase has passed; and works like Dr. Fossum's, attempting a literal following of the words of both sagas, with no allowances or as few as possible, are perhaps a natural reaction.

A Middle Ground Possible

We need not go quite to either extreme. It is unnecessary to shut our eyes to certain elements of myth in the sagas, but we may wisely decline to treat as purely mythical the plain statements of real products and conditions that are still found *in situ* and only needed finding then. Similarly, there is no need to treat as something too precious to be tampered with such statements as that they sailed just two days before making each of their first three discoveries. This conventional formula would readily slip in from a saga man's pen long afterward, as would also some hints of direction that have occasionally been held to require very great precision in construing; also such a bit of careless attribution as the skin boats alleged to be in use by the Indians at Hóp. Possibly this may likewise be true of the explosive Indian weapon which is still inadequately explained, for it surely is not the archaic Algonquian two-men club, as Schoolcraft once fancied.

Antecedent Probability of a Norse Visit to Cape Cod

It has often been said, very soundly, that even if there were no sagas and records of voyages we must believe that a daring race of seafarers like the Norsemen could not remain several centuries settled in Greenland without visiting by accident or design the neighboring regions of America. It is likely that Eric touched, or at least saw, Baffin Land in the course of his first three years' Greenland explorations. If not, hunting parties of the Nordsetr men were certain to do so before long. Labrador, too, lying next below, and also offering a broad front to Greenland across a comparatively

narrow sea, was plainly marked by destiny for early discovery. These things are obvious. As to lower regions, it is true that neither Baffin Land nor northern Labrador would offer much suggestion of more hospitable climes to lure the visitors farther southward; but there remained the probability of a chance southern landfall, storm-driven, in an age when charts and compasses were wanting and men were greatly at the mercy of wind and weather. A report of warm, rich southern country, a veritable earthly paradise to men from relatively cheerless and meager latitudes, would surely reinforce the zeal of southward-coasting explorers, so as to carry them well on toward the abundance and comfort reported. According to the saga, this was just what happened. Leif, on the long transatlantic voyage from Norway, was storm-driven from his course for Greenland and brought to Vinland, probably not farther north than Cape Cod and possibly much below it. On his very favorable report, Thorfinn Karlsefni and his friends organized an expedition of would-be Vinland settlers and followed the American coast downward, perhaps at first in wide loops of sea sailing, as knowing that they could not yet be near a desirable home site, but afterward more closely, scrutinizing as they sailed, until they reached a bay of northern Vinland with a country about it very lovely in summer time, though sure to prove dangerously unproductive and cold in winter—as they could not yet know.

It all happens in the saga as it naturally would happen, and the best proof of general authenticity is that, according to its record, the Norsemen found what they were sure to find—since it was really there. The capital item of allurement, Vinland (Wineland) the Good, lay in waiting all the time, a land where great beds of wild grain bordered the estuaries and shallow parts of rivers; a land of ample timber growth where grapevines festooned the wooded hillsides, often yielding large grapes of delightful flavor; an extensive land, stretching up and down the coast, in parts bending far out eastward and warm enough in its lower reaches to suggest a connection with Africa.

Markland and Helluland

Markland and Helluland, of course, were also there, distinguished by their characteristics of forestry and stoniness, with all kinds of game in the one and Arctic foxes in the other. Some latitude may be allowed as to their boundaries, which doubtless were not very clear to the Greenlanders or the later saga men. Undoubtedly Newfoundland was a forest land (Markland), and the term may then have included also a part of southern Labrador for the same reason.[22] It was equally certain that if the explorers searched far enough they would find the Furdustrandir, a stretch of seemingly interminable flat sands and dunes sometimes on the mainland sometimes with a long, shallow lagoon between. This is a practically unbroken formation for all the shore south of New York; also, with one or two breaks, for that

[22] W. H. Babcock: Markland, Otherwise Newfoundland, *Geogr. Rev.*, Vol. 4, 1917, pp. 309–315.

between New York and the tip of Cape Cod. North of that it can hardly be said to exist, except in minor stretches, the most considerable and characteristic of which is probably the Atlantic front of Richmond County, Cape Breton, where boats are said to be hauled sometimes across the low isthmus of St. Peters to the inland water known as Bras d'Or. Nine hundred years ago the low strands of this Nova Scotian part of the coast may have been much more extended than now. Whether or not these were specifically the beaches intended, the explorers certainly must have had afterward ample experience farther southward with the strands which seemed so long that the vessels would never have done sailing by them and so were named the Wonderstrands. Possibly these may have been dislodged from their proper place in the narrative. It is more important to note that here was something real and great, something of which the Norsemen could have no inkling from home experience, but which they found and recorded.

Corroborating Features

Certain more restricted coastal features add corroboration. An island (Straumey) with strong currents about it set in front of an inlet and bay (Straumfiord) with fine grass country about it may not be exclusively American; but the combination is rather unusual, and some search would be required to find it in either hemisphere. It is found, however, at the mouth of the Bay of Fundy in Grand Manan Island, Grand Manan Channel, Passamaquoddy Bay, and the surrounding region. Again, the saga calls for a peninsula extending northward and containing a river flowing from the east to the west. This peninsula or a conspicuous point on it is named Keelness (Kjalarness). Stefánsson's map of 1570 (or 1590) names it Promontorium Winlandiae, showing that tradition held it to be the northern extremity of Vinland. Now there are four northward peninsulas on our coast; the upper end of Labrador just south of Hudson straits and barred by its practically Arctic conditions; the northern peninsula of Newfoundland, riverless and far too chill; Cape Cod, which has no rivers; and the western northward-jutting part of Cape Breton Island, which has Margarie and Mabou Rivers, flowing as stated in the saga, and quite fulfills every requirement.

From Straumfiord, we are told, Karlsefni made a year's expedition southward, apparently seeking more favorable winter quarters. Sailing "a long way," his men established themselves at a Hóp, into which a river emptied before passing thence to the sea. They found vines and wild grain in all suitable places. In the winter it was so mild that their cattle lived by pasture and no snow fell—perhaps, as previously stated, we should understand none that would cover the ground and interfere with grazing. The conditions indicate a part of Vinland such as Leif had previously visited and such as was more worthy of the name. Several nearly landlocked bays in the middle parts of our coast would supply all that is called

for, perhaps none better than Mount Hope Bay between Rhode Island and Massachusetts.

One finds verisimilitude also in the behavior of the Indians, who first traded with them, afterward fought them, and were beaten off with difficulty, so that the white men judged it best to go back to Straumfiord. The story of the battle is very realistic and with the description of the natives must have come at first from an eyewitness, though the saga man may be responsible for a few interpolations as suggested above. The Norsemen would have had no data from which to invent these Indians. They must simply have experienced them.

Some question has been raised about the absence of "mountains" from the neighborhood of Passamaquoddy Bay and of Mount Hope Bay, though they are mentioned as at Straumfiord and Hóp in the saga. But what is a mountain? In the former instance the context shows that nothing Andean or Alpine could have been intended. Rather the reference is to such gracious fells or high rounded hills as we actually find. There is no mention of mountains in the description of Hóp. One manuscript only in dealing with a quite different region refers to the mountains which were at Hóp. If this be authentic, it may refer to the range of hills running northward from behind Fall River; but in any event it is too slight a reliance to control the identification of an important station.

The Probable Course of Karlsefni's Expedition

In view of the above considerations it seems most likely that Karlsefni's expedition of explorers and intending settlers, after sailing south or southwest from known regions in western Greenland and barely landing on the treeless and cheerless front of upper Labrador, made a brief but longer stay in Newfoundland among the abundant game of its forests, crossed the strait of Cabot to the low sands and upjutting northern horn of Cape Breton Island but declined to round that cape into the Gulf, preferring to follow down the Atlantic face of Nova Scotia instead. This brought them to a bay-indented sea front and especially to the Bay of Fundy and its branches, the sweeping sides of which would attract double attention after the slightness of ebb and flow along the coast last left behind them. Here they established their home in a pleasant grassy country, bordering on Passamaquoddy Bay, with Grand Manan Island lying out before it. Here, too, they probably made the observation of *eyktarstadr* and *dagmalastadr* which has been such a bone of contention, being commonly assumed, without warrant, to mark their most southern point of travel. When food grew scant in winter time they moved out to the island, with some gain though still unsatisfied. They were within the borders of Vinland, but far north of its warmer parts which Leif had reached. The country about them was not a land of grapes, though in season a few specimens might be brought by scouts and runners from rather distant points. Wine was simply not to be

had. A search for a home site more truly representative of Vinland became urgent.

A minority of the explorers, led by Thorhall the Huntsman, thought it was to be found by sailing around Cape Breton Island to the Gulf beyond, and they departed in that quest with one vessel. But Karlsefni rightly judged that the greater (and doubtless the warmer) stretch of coast lay southward and sailed that way a long distance, perhaps crossing the Gulf of Maine directly, but possibly skirting its curved shore instead. The nearly landlocked bay, or Hóp, where he planted himself again, among the hills full of grapevines and the low grounds full of wild rice, may have been as far north as Ipswich, Massachusetts, but the conditions seem better met by some part of the southern face of New England, such as Mount Hope Bay. They landed and built their houses in the spring and lived there in comfort through the next summer and winter—the winter an exceptionally mild one—but, after a sojourn of a year, the hostility of the neighboring Indians drove them back to Passamaquoddy Bay.

Then Karlsefni with one ship essayed Thorhall's route, sailed around Cape Breton's upjutting promontory, and reached the mouth of the Marjorie or Mabou River, well down on its western side. Here again native hostility awaited him, and Thorvald Ericsson was killed by a sharpshooting archer. A futile chase left them with the impression that the aggressor was more and worse than human. So, to save the rest of their party, they hastened back again to Passamaquoddy. Then, baffled and disappointed and quarreling among themselves, they finally left Vinland altogether for Greenland, pausing at Markland on the way.

It seems that Rafn was about right as to the most southerly point reached, but his identification has suffered by the character of the supplemental local evidences brought forward needlessly in its support. The round tower, Dighton Rock, and the "skeleton in armor" do not recommend any hypothesis; but it is unfortunate that they should seem to detract from one entitled to serious consideration without them. Whether Leif touched the coast still farther south must remain a mere matter of fancy. Hóp seems to have supplied the conditions and data which he had reported.

There may have been other Norse voyages to America, we cannot estimate how many, and it is possible that the Flatey Book narrative may perserve a few items contributed by them; but it seems to me that Thorfinn Karlsefni's elaborate and long continued endeavor adequately to explore and permanently to settle is the only one of which we have a report that will enable us to trace it approximately in some detail, notwithstanding the strange way in which the narrative grew up into its final form; and that the course of events—and of the intending colonists—must have been pretty nearly as herein described.

PLOVER LAND AND BORDEN LAND

By Vilhjalmur Stefansson

In the Arctic, real lands have surpassing skill in hiding themselves, while lands that never existed appear clear and indubitable to the eyes of the keenest and most experienced explorers.

In 1826 Sir John Richardson, then on his first Arctic voyage, sailed close by Clerk Island in Dolphin and Union Straits. On his second voyage in 1848 he tells us that because of unfavorable conditions he passed Clerk Island without seeing it. No one has seen it since. In 1911 I traveled by sled over the site of it. Down to that time Clerk Island appeared on the Canadian Government maps, but it will not appear in future.

Several other Arctic lands, after being reported by men of authority, have kept their places on the chart for one or several generations but are now gone forever. Others have been rendered doubtful or have at least been compelled to retreat before the advance of knowledge. In this class are Sannikov Land, the existence of which has been rendered doubtful by the voyage of the *Taimyr* and the *Vaigatch*, and Crocker Land reported by Peary.

It seems to me that Crocker Land should still be granted a period of grace. MacMillan marched into the edge of it (as plotted by Peary) and found only sea ice. Had he taken soundings and found abysmal depths, the case against land being there would be impregnable. But he took no critical soundings, and the soundings taken on our journey aimed towards the same general locality in 1917 grew no deeper as we went away from the known lands but continued to be of a "continental shelf" character for 150 miles as we traveled towards Crocker Land. I suggest that we let Crocker Land bide till the vicinity is sounded and shown to be deep water, or till the region is explored so thoroughly that we know it is not merely hiding.

For some Arctic lands, as has been remarked, have shown striking aptitude in hiding. The strait between Cape Chelyuskin and Nicholas II Land is but 60 miles wide and the land to the north is high, even mountainous, and yet that passage was traversed by Nordenskiöld in 1878 and Nansen in 1893 without either of them suspecting that it was a strait. The discovery remained for Vilkitsky in 1913.

It is only about 60 miles north from Cape Parry to Nelson Head on Banks Island, and Nelson Head is a bold cape with high hills or low mountains just behind it—3,000 or 4,000 feet high. I have at various times spent altogether several months at Cape Parry, and nearly every day I climbed the highest hills there (300 or 400 feet) with field glasses to look northward for bears and seals and incidentally for land. And yet, only two or three times have

I seen Nelson Head, but each of those times I saw it clearly, well above the sky line.

In 1853 Leopold McClintock, to me the most capable and admirable of the entire noble line of British naval men who laid the American Arctic bare to our eyes, was at what we now call Cape McClintock at the northern end of Prince Patrick Island and did not see the large land which we discovered sixty-two years afterwards lying only 30 or 40 miles to the northeast. Nay more, he says in the record which we found in his cairn at Cape McClintock that he had visited "the islands and reefs lying to the northward." I have since examined his manuscript map, sketched into his diary at the time, and this shows that he had seen some small sand bars that are 15 or 20 miles north-northeast of Cape McClintock, or only that much distant from our New Land. I have also stood at Cape McClintock looking northeast without seeing anything but what he saw. I then went to the "islands and reefs" which he visited and even to those beyond, which he saw only from a distance, still without seeing land beyond. And the day was apparently clear. But later, on days of more favorable weather conditions, I have climbed up the hills on our New Land and seen Prince Patrick Island and all the intervening islands and sand bars.

Having justified by a few examples our thesis that nonexistent lands reveal themselves while real ones lie in hiding, we come to the interesting case of Plover Land.

Kellett's Plover Land

Captain Kellett, who was McClintock's superior officer in 1853 (when McClintock discovered Prince Patrick Island and left there the record quoted above), had three years earlier been in command of the *Herald* on her Beaufort Sea voyage when she discovered Herald Island. After telling about discovering and landing on Herald Island Kellett reports that in about latitude 72° N., longtitude 175° W., there is an extensive land upon which he did not set foot. In his account the following is perhaps the most striking passage:

> There was a fine clear atmosphere (such a one as can only be seen in this climate), except in the direction of this extended land, where the clouds rose in numerous extended masses, occasionally leaving the very lofty peaks uncapped, where could be distinctly seen columns, pillars, and very broken peaks, characteristic of the higher headlands in this sea—East Cape and Cape Lisburne, for example. As far as man can be certain who has 130 pairs of eyes to assist him, and all agreeing, I am certain we have discovered an extensive land.[1]

Other Voyages in the Vicinity of Plover Land

Plover Land (named for the companion ship to the *Herald*) was put on the charts. But later Commander Rodgers in the U. S. S. *Vincennes* ran through the position as indicated on the Admiralty chart and anchored in 42 fathoms in latitude 72° 5′ N., longitude 174° 37′ W., where Plover Land

[1] Papers and Correspondence Relative to the Arctic Expedition under Sir John Franklin, Parliamentary Papers, 1850.

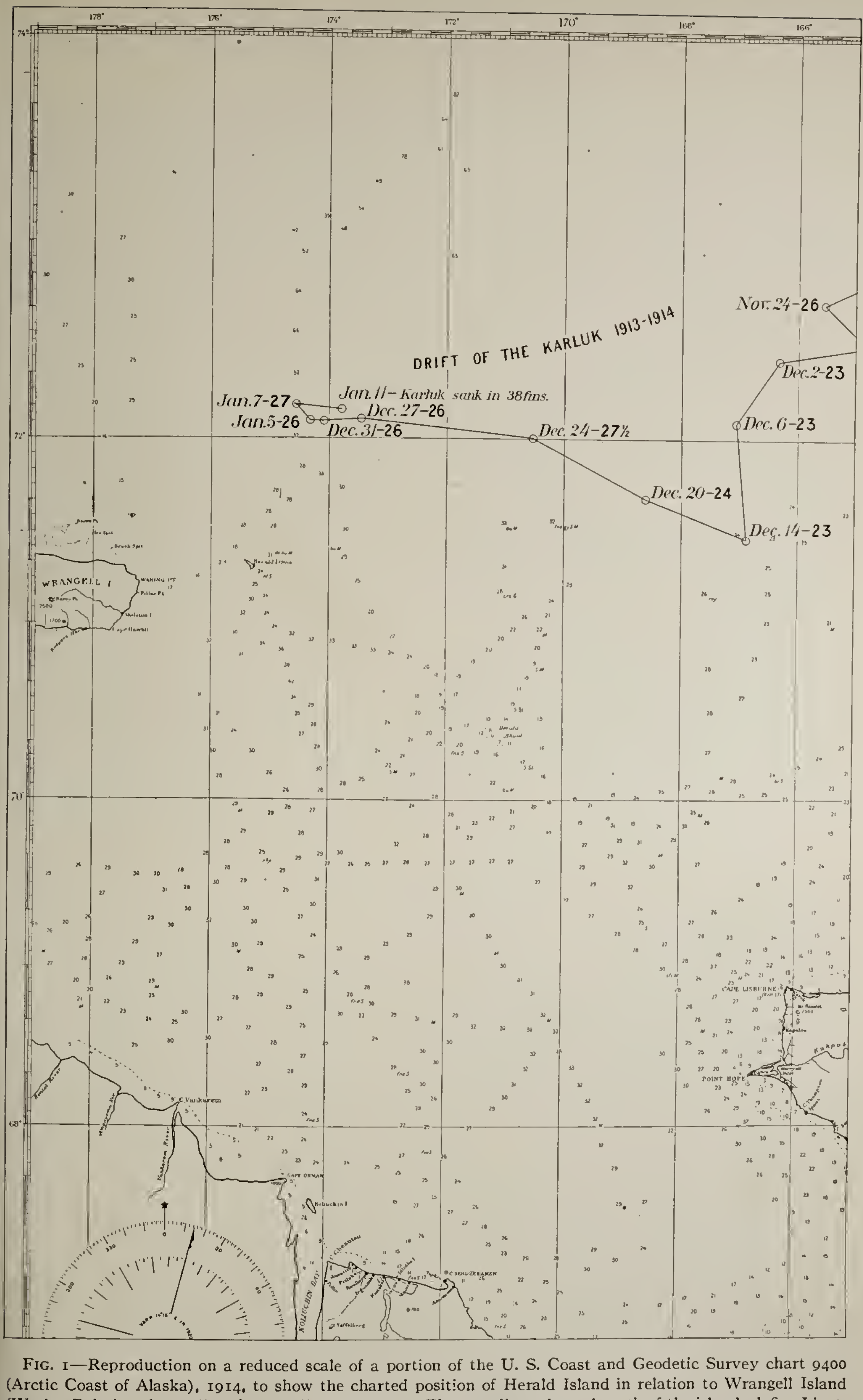

FIG. 1—Reproduction on a reduced scale of a portion of the U. S. Coast and Geodetic Survey chart 9400 (Arctic Coast of Alaska), 1914, to show the charted position of Herald Island in relation to Wrangell Island (Waring Point) and soundings in the adjacent waters. The soundings charted north of the islands define Lieut. Berry's course in the U. S. S. *Rodgers*, 1881 (compare the chart, p. 143, reproduced to accompany G. W. Littlehales: The Navy as a Motor in Geographical and Commercial Progress, *Bull. Amer. Geogr. Soc.*, Vol. 31, 1899, pp. 123–149 and note the map on p. 148, showing the drift of the *Jeannette*). On the chart has been plotted the last stage of the drift of the *Karluk* dates being given and soundings in fathoms.

should have been, and reported that for thirty miles in every direction there was no land though the weather was so clear that the horizon was apparently without limit.[2] A little doubt, however, is cast on this testimony by the fact that on the same voyage Commander Rodgers failed to see Wrangell Island although, according to his reported astronomical observations and our present knowledge, he was only a few miles from it. After all, the position assigned to Plover Land by Kellett was only approximate; there may also conceivably have been an error of position in Rodgers's reckoning.

Later the ship *Rodgers*, commanded by Lieutenant Berry,[3] reported reaching latitude 73° 44′ N. in longitude 171° 48′ W. without seeing land. If we consult the standard charts we find the whole vicinity of Plover Land sounded. But the figures show shallow water, as if the facts were determined so to balance themselves as still to leave a possibility of land. We may also remember that, if it be supposed that Kellett was nearer to the land than he thought, he may have overestimated its extent.

We now come to the reason for the writing of this paper. Plover Land has again been seen.

Plover Land and Borden Land

In the spring of 1914, after the wreck of the *Karluk* a short distance to the northeastward, several members of our expedition remained encamped at Waring Point, Wrangell Island, for several months. During that time a land other than Herald Island was seen one day to the eastward and was repeatedly seen thereafter. The two most important witnesses are John Hadley and William McKinlay.

The Testimony of Hadley

John Hadley, a native of Canterbury, England, had spent most of his life in the Arctic since he went thither in 1889 as petty officer on the U. S. Revenue Cutter *Thetis* sent to determine whether the station of the American whaling fleet at Herschel Island was in Alaska or Canada. Some of the time he had been aboard whaling ships,[4] but for the most part he had been engaged in whaling from a shore station either at Point Hope or Point Barrow. I met him in 1908, and from my first meeting my liking and admiration for him increased continually. He was one of the most valuable members of our expedition of 1913 to 1918. For fifteen months in 1913–1914 he was with the *Karluk* section of that expedition. I re-engaged him in 1915, making him second officer of the C. G. S. *Polar Bear*, of which he later became captain.

In point of years Hadley's Arctic experience has never been equaled by any explorer, so far as I know. He had, for instance, spent there more than twice as many winters as Peary, even before he joined our expedition.

[2] Rept. of the Secretary of the Navy, Dec. 3, 1881, Reconnaissance of Behring's Straits, pp. 7–9.

[3] Rept. of the Secretary of the Navy, Nov. 28, 1881, pp. 6–9, 755–763.

[4] See "Whaling off the Alaskan Coast: From the Journal of Jack Hadley of Point Barrow, Alaska," *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 905–921.

These were not inactive years ashore, for every spring he was out with companions both white and Eskimo fighting the ice and weather in the strenuous sport of catching that biggest of all game animals, the bowhead whale. Colonel Roosevelt once planned to hunt bowhead whales on the northern coast of Alaska. He might have found it braver sport than hunting lions in Africa: he certainly would have found it more healthful than the South American jungle. Hadley had found it healthful. His eye was still keen, and so was his enjoyment of life; his judgment was sound by nature. These considerations lend weight to his story of what he called "Borden Land."

It was from higher ground in the vicinity of Waring Point that Hadley first noticed a new land beyond Herald Island. The northern tip of this land was hidden by Herald Island, and it extended about 25° south. His first thought on seeing it was the strangeness of not having seen it before, especially on the march ashore after the wreck of the *Karluk*. When he made a statement to that effect to the Eskimo Kurraluk, the Eskimo replied that he had seen the land both from the ice after the *Karluk* was wrecked and while the party were still encamped there and also while they were on their way to Wrangell Island. Hadley inquired from the other men whether they had seen the land, but none of them had noticed it. He did not consider this strange, for he assumed that it would have been covered with snow at the time and perhaps only indistinctly visible, being but a white outline on a white horizon. Had it been distinct, he himself certainly would have noticed it.

After the land had first been seen it was visible whenever weather conditions were suitable. It is a matter of common knowledge that the absence of fog in one's immediate vicinity is no guarantee that there is not a thick fog bank lying invisible a few miles away and hiding everything beyond. Accordingly it did not strike Hadley as remarkable that on many apparently clear days the land could not be seen.

After the land had been seen three or four times and there was general agreement as to its reality, it was decided to name it "Borden Land" in honor of Sir Robert Borden, who had been chiefly instrumental in securing the transfer of our expedition from American auspices to those of the Canadian government.

Hadley considered the most important fact about the land to be this, that when it was first seen it was to a large extent covered with snow and that day by day the snow could be seen to be getting less and less, so that when the land was last seen the snow was mainly confined to what appeared to be gullies or the slopes of hills. He said he had no doubt at all of the existence of the land; the fact that it was not seen from the decks of either the *King and Wing* or the United States Revenue Cutter *Bear* when they were cruising in the vicinity of Herald Island looking for the missing members of the expedition, he considered to be of no significance. A fog to the northeast would, in his opinion, have explained its non-appearance.

This, in substance, is what Hadley told me. As he has since died, I will fortify myself by quoting Archdeacon Hudson Stuck's account of his interview with Hadley on this subject. The time of the Archdeacon's visit to our camp was late March, 1918. I quote from his most interestingly written book, "A Winter Circuit of Our Arctic Coast":

Ten miles more brought us to Barter Island and to the extensive building, half underground in sensible vernacular fashion, of Mr. Stefansson's base camp, and here we were hospitably received by Captain Hadley, who was in charge. . . He had been on the *Karluk* when she was lost, full of scientists and all sorts of expensive and elaborate equipment, and bore no small part in bringing the survivors to Wrangell Island, there lying many months until rescued by the *King and Wing*. Having just read the "Last Voyage of the Karluk" it was illuminating in many ways to hear Captain Hadley's account.

But what interested me most keenly was his statement that while on Wrangell Island, again and again, on clear days, he had seen land with mountain tops far to the northeast. . .

I plied Hadley with questions: There could be no possibility that it was cloud banks he saw or mirage? How could it be when it lay always in the same place and bore always the same shape? Could he make any estimate of the distance? It was very far off, perhaps an hundred miles, perhaps more; it was impossible to say, but it had bold rugged mountain peaks covered with snow in places and in places bare. I reminded him of the *Jeannette* drift, of the *Vincennes* voyage, of Berry in the *Rodgers*. Yes, he knew of the two former though he seemed to think there was some doubt about the last, but it did not matter how many said there was no land there, he had seen it again and again, and had no more doubt about it than about the island we were on now. How many times altogether could he say that he had distinctly seen it? Well, he had made no count; every thoroughly clear day; and he said that though clear days were rare, when they were clear they were wonderfully clear. Had he seen the land twenty times? Yes, fully twenty and probably more.

So there it stands: Rodgers did not see Wrangell Land for fog, though but a few miles off his course; there may have been other land he did not see; the *Jeannette* drifted steadily northwest away from Herald Island and in this land is reported northeast. And Hadley's testimony agrees remarkably with Kellett's description.[5]

The Testimony of McKinlay

William Laird McKinlay is a Scotchman, a graduate of Glasgow University where he specialized in mathematics and physics. On our expedition he was in charge of the investigations in terrestrial magnetism. Apart from his lack of Arctic experience he was by training about as well equipped as anyone could be to report on the phenomena here in question.

Before deciding to publish Hadley's account I wanted McKinlay's story. I quote his letter verbatim, so far as it related to Borden Land. The sketch map is exactly as he drew it.

With reference to what Mr. Hadley may have told you regarding appearance of land, I do not suppose that I can add much, but I can certainly confirm that evidence. The appearance of land was seen only on days when conditions were fine and clear. It bore roughly east to east-northeast from our position in the small bay at Waring Point in which our camp was situated, its northern end being in line with the southern end of Herald Island, and it was visible to the south for a distance roughly four times the length of Herald Island, as the latter presented itself to us in our position at that time. I have not sufficient

[5] Hudson Stuck: A Winter Circuit of Our Arctic Coast, New York, 1920, pp. 304–305. (Reviewed in this number of the *Geographical Review*.)

experience of the effects of mirage in polar regions to be able to say whether such appearances may have been due to such a cause; but probably the fact—and this was to me the one really noteworthy fact—that, making allowance for the slight variations in conditions of visibility on clear days, the outline was on all occasions practically identical, rules the consideration of mirage out of the question, and renders the actual existence of land more probable.

Beyond the outline it was hardly possible for us to note much detail, beyond the fact that the side presented to us seemed to consist for the greater part of its length of cliffs or steep slopes. On one occasion there appeared to be a decided gap, separating the land into two distinct parts; but, whether due to defects in visibility near the surface or not, this was not generally noticeable. It was impossible for us to make even a rough estimate of the distance

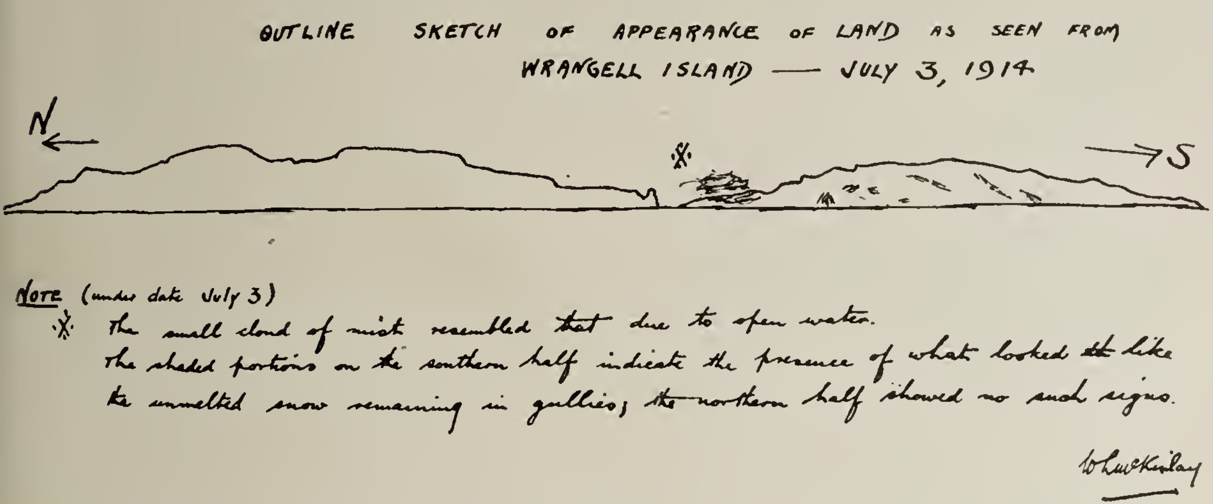

FIG. 2

of the supposed land; but the height at the highest point appeared slightly less than that of Herald Island, although, of course, the fact that it was much farther distant than Herald would mean that this lower altitude was apparent rather than real.

Perhaps I cannot do better than give you an extract of a few brief notes bearing on this, under dates when the land was seen, together with a rough sketch of the outline and weather notes for each day.

Wednesday, June 17, 1914

Appearance of land in direction of Herald Island, bearing roughly ENE. Apparently much farther off (than Herald Island).

Weather—calm; light airs. Completely overcast in early morning; clear all day thereafter.

Friday, June 19

The island again shows up clearly with unchanged appearance. If land, it is something new and uncharted.

Weather—wind south, light to strong breeze. Cloud—few stray cirrus.

Saturday, June 20

Our island again showed up clear and unchanged. Hadley and I have decided to name it Borden Land.

Weather—wind south, variable from light to strong. Cloud—few Ci.

Sunday, June 21

Hadley reports having seen our island again when he went out this morning, but indistinctly.

Weather—wind east, light to moderate breeze. Cloud, $Ci._{2\ 3}$ fog, not dense, from 3 till 7 P.M.

Friday, June 26

Our island was again clearly visible, with what appeared to be a gap cutting it in two. The constancy of outline almost convinces us that it is actually land, but it is hard to believe that the Karluk drifted through that region without it being sighted.

Weather—wind light and variable. Clear all day; $Ci.Cu._2$ in evening.

(Fog and conditions of bad visibility intervened until July 3.)

Friday, July 3

Our island has been remarkably clear today; unchanged outline.

Made a rough sketch of this outline.

Weather—wind at first SE light, but later variable. Clear in forenoon; completely overcast later.

From that date until the *King and Wing* arrived, on September 7, conditions were uniformly bad, indeed, only four days appear in the total of 65 which could be described as clear—August 1 to 4—and probably the fact that we were constantly on the ice or in its neighborhood in search of game accounts for no mention of our seeing a recurrence of the appearances noted above. In that period of 65 days 22 were foggy or misty, rain fell on 8, and snow on 12; while 17, on which none of these phenomena was noted, were "completely overcast."

From a study of the track of the Karluk's drift you will see that from the first week in December the ship was never very far north of the line in which the supposed land appeared to be; and no point on that line is any farther south of the ship's track after December 13 than where land was sighted on December 29, bearing S by W (Herald Island). Moreover from December 14 to December 29 every day with two exceptions was clear either all day or part of the day; but I have no knowledge of any appearance of land having been noted by any member of the ship's company during that period. This fact, together with the knowledge that the charts show that region to be more or less sounded, made me very much inclined to doubt the probability of the existence of land in that direction; but so far as the testimony of our vision can go, I can assure you that I can strongly corroborate Mr. Hadley's statements that we did see appearances of land. Indeed, it was, as I have already remarked, the noteworthy fact that the outline was on every occasion practically the same that most impressed me and finally led me to make the rough sketch I enclose.

The following notes on McKinlay's account are pertinent:

1. He refers to the southern end of Herald Island as being northeast from Waring Point, while by the American and British charts it is east or but a few degrees north of east. It is more likely that the charts are wrong either as to the position of Herald Island or as to that of Waring Point than that McKinlay erred so much in giving the direction of the one from the other.

2. That there should be a gap seen in the land on one occasion does not affect the evidence as to the presence of land. I have frequently seen such gaps in lands well known to exist—the cause being either a mirage or a fog bank lying on the land. It is for this reason that some large bays laid down on polar charts are found to exist only on the charts—a gap appearance caused by fog or mirage has been taken for a bay.

3. The hardest blow against Borden Land is struck by McKinlay's statement that from December 14 to December 29 every day with two exceptions was clear and that no land was seen, so far as he knows. According to the chart, the *Karluk* should during this time have been in a northerly direction from Borden Land, and it is well known to all Arctic travelers that conditions for seeing land to the south can never be more favorable than exactly at this time of year when any land, no matter how snow-covered, would be seen as a clear silhouette against the southern dawn.

But this statement is offset by the one by Hadley that the Eskimo Kurraluk did see the land to the south during the period in question. Hadley believed it might have been seen by the Eskimo even though it had escaped his own notice. And, because of his experience and habits of close observation, Hadley was certainly more likely to notice it than anyone else, with the possible exception of the Eskimo.

Thus the facts try continually to counterbalance each other, alternately introducing doubt into our certainties and canceling our doubts. It seems reasonable, however, that if the Borden Land of Hadley and McKinlay and the Plover Land of Kellett are existent they are one and the same. But if the various accounts are to be reconciled, it will be necessary to shift the charted positions of either Point Waring or Herald Island, or both. That may not prove so difficult as it seems, for the observations of our expedition have already shifted the positions of several such well-known landmarks as Cape Parry and Cape Bathurst as much as twenty miles. In the far north faith in the sextant and chronometer occasionally moves mountains.

GEOGRAPHICAL RECORD

THE AMERICAN GEOGRAPHICAL SOCIETY

Lectures and Elections to Fellowship. In the last issue of the *Geographical Review* announcement was made of the speakers and subjects at the January and February meetings. In addition there were given two lectures in the technical series at the home of the Society, Broadway at 156th Street, as follows:

On February 8th Dr. E. L. Stevenson addressed the Society on the subject of "Maps in the American Geographical Society's Collection Relating to Early Exploration and Discovery." There was distributed at the lecture a pamphlet of twenty-one pages, especially prepared for the occasion, entitled:

A DESCRIPTION OF EARLY MAPS
Originals and Facsimiles
(1452–1611)

Being a part of the permanent wall exhibition of
The American Geographical Society
With a partial list and brief references to the reproductions of others which may be consulted in the Society's Library.

Under each main map title in the pamphlet there is about a page of text description together with a brief list of references.

It was the good fortune of the Society to have Dr. D. G. Hogarth, of Oxford University, give a special illustrated lecture, Tuesday evening, March 1, on "Recent Explorations in Arabia." There was an attendance of over four hundred Fellows and friends, and an unusually high degree of interest. An illustrated article by Dr. Hogarth will appear in the July number of the *Geographical Review* on the subject of his lecture.

At the Society's building on April 12 Alan G. Ogilvie, of the staff of the Society, will give an illustrated lecture on Macedonia. Mr. Ogilvie was a Captain in the British Army during the war, spending most of the war period in surveying portions of Macedonia. He is the author of an article on that subject in the present number of the *Review*, and of a number of papers in the *Geographical Journal* (London). Mr. Ogilvie is a graduate of Oxford University and was Reader in Geography at the University of Manchester at the time his present appointment was made.

At the January, February, and March meetings, President Greenough presiding, there were presented with the approval of the Council the names of 224 candidates who were duly elected as Fellows of the Society. An account of the annual meeting of the Society involving the election of officers is given in the following paragraphs.

Annual Reports of the Society. At the annual meeting of the American Geographical Society held on January 25 at the Engineering Societies' Building, 29 West Thirty-ninth Street, the annual reports of the Council, of the Treasurer, and of the Special Committee were read, as follows:

Report of the Council

January 20, 1921

The Council presents herewith a brief review of the activities of the Society during the past year. These have recovered in large measure from the dislocation caused by the Great War.

The work of the Society has been directed toward the achievement of two principal objects: the first seeking to meet the interest of our Fellows through the *Geographical Review*, the *Annals of the Association of American Geographers*, the monographs, and the

lectures; the second involving an effort to add to the permanent fund of geographical knowledge by original research and exploration. The results of the latter endeavor must necessarily be restricted by the limited means at the command of the Society, but we are gratified to announce that through the generosity of some of the Council we have been able this year to initiate an extended scheme of intensive scientific research in the geography of Hispanic America and Brazil.

The first step in the development of the program aims at the review and classification of all available scientific data of a geographical nature that pertain to Hispanic America. Topographic data of all kinds, climatic facts, and population statistics are of first importance. Account is taken of everything in man's physical environment that affects his distribution, his activities, and his economic welfare. While such a study reaches back into history it is most concerned with present conditions and the possibilities of the immediate future. The work will involve the compilation of maps—topographic and distributional—on various scales; but always including sheets on the scale of 1:1,000,000 which will conform to the scheme of the International Map. It further includes the production of complete distributional maps of Hispanic America dealing with soil, vegetation, and land classification. The undertaking proposed is an ambitious one, but the Society is happy to say that assurances of co-operation have been given by the whole group of Hispanic American countries in a cordial spirit that augurs well not only for immediate scientific results but also for the fostering of mutual understanding and sympathetic relationship towards which the field of geography offers a peculiarly fortunate approach. Details of progress will be presented from time to time to our Fellows through the columns of the *Review*.

The *Geographical Review*, which has heretofore been published as a monthly periodical, will hereafter be changed to a quarterly issue, giving it a more permanent shape which it is hoped will meet with your approval. Various technical considerations as well have contributed to this decision.

The projected series of monographs in the Research Series, alluded to at our last Annual Meeting, has advanced so that it includes altogether fourteen numbers. The two leading publications are now in press and are entitled, "The Battlefields of the World War: A Study in Military Geography," by Professor D. W. Johnson, of Columbia University, about 600 pages, 170 illustrations; and "The New World: Problems in Political Geography," by Dr. Isaiah Bowman, Director of the American Geographical Society, 600 pages with over 200 maps and 60 photographs. Order cards for these monographs have already been distributed to our Fellows.

Additions to the Library comprise 1,406 books, 519 pamphlets, 5,308 periodicals, 3,482 maps, and 34 atlases. Our collection now comprises 57,210 books and pamphlets, 50,643 maps and atlases.

The gold medals of the Society were awarded as follows: The Charles P. Daly Medal to Dr. George Otis Smith, Director of the United States Geological Survey, Washington, D. C.

The David Livingstone Centenary Medal to William Speirs Bruce, of Edinburgh, Scotland, for his distinguished work in the Antarctic.

The David Livingstone Centenary Medal to Alexander Hamilton Rice, New York, for explorations of north-western Amazonas.

The lectures of the Society have been well attended and have given general satisfaction. These, eleven in number, were given by the following speakers: Dr. Charles Upson Clark, Professor Clarence H. Young, Archdeacon Hudson Stuck, Mr. Carl Lumholtz, Professor Henry E. Crampton, Dr. Fay-Cooper Cole, Dr. George Otis Smith, Mr. Edgar J. Banks, Mr. Roy Chapman Andrews, Baron Gerard de Geer, and Dr. Alexander Hamilton Rice.

The number of Fellows of the Society is 3,307, of whom 397 are Life Fellows.

The Report of the Treasurer, submitted herewith, gives a summary of the income and expenses of the Society, together with a condensed balance sheet showing a satisfactory financial condition.

In conclusion, it may be said that the organization was never better fitted for the purpose it is designed to serve and the hope is entertained that its disinterested efforts are appreciated by the community. Our acknowledgments are due to all the members of the staff for their efficiency and devotion.

Respectfully submitted on behalf of the Council.

John Greenough
Chairman

Report of the Treasurer for 1920

The following is a statement of the receipts and expenses and the condensed balance sheet of the Society as shown by the books on December 31, 1920:

Receipts and Expenses

On December 31, 1919, there was at balance of income account		$2,377.14
During the year there have been received from annual dues, interest on investments, and sales of publications	$61,049.49	
Special donations	13,000.00	
		74,049.49
		76,426.63
There has been expended for salaries, house expenses, library, meetings, publications, postage, insurance, etc.		75,961.03
Balance of income account December 31, 1920		$465.60

Condensed Balance Sheet

Cash	$30,781.99	Capital uninvested	$1,872.96
Temporary investments	45,041.76	Annual dues paid in advance	330.00
		Monograph Publication Fund	11,008.44
		Hispanic American Research Fund	33,480.24
		Sundry deposits and reserves	21,166.51
		Special deposit	7,500.00
		Income account balance	465.60
	$75,823.75		$75,823.75

Henry Parish
Treasurer

Report of the Special Committee

January 25, 1921

The Special Committee appointed December 16, 1920, to nominate and invite suitable persons to fill vacancies which will occur in the offices of the Society at the date of its annual meeting in January, 1921, respectfully report that they recommend the election of the following gentlemen to the offices designated:

		TERM TO EXPIRE IN
President	John Greenough	1922
Vice-President	Alexander Hamilton Rice	1924
Foreign Corresponding Secretary	William Libbey	1924
Treasurer	Henry Parish	1922
Councilors	Edwin Swift Balch Banyer Clarkson H. Stuart Hotchkiss Walter B. James Frank L. Polk	1924
	Franklin D. Roosevelt Roland L. Redmond	1923

Philip W. Henry
W. Redmond Cross
Paul Tuckerman
Committee

The reports of the Council and the Treasurer were approved and ordered on file. The persons recommended by the Special Committee for the offices to be filled received the unanimous vote of the Society and were declared duly elected.

NORTH AMERICA

Weather and Crop Yields in the United States. The detailed study of weather and crop relations has led to recognition of one or more critical periods in the growth of a crop, when its future prospects are largely determined. Thus, for corn, Professor J. Warren Smith has shown that the time when an extra half inch or quarter inch of rain is most valuable, is the 10 days immediately following the blossoming. The temperature as well as the moisture of a critical period exercises an important control over crop development. For instance, in the case of the cotton belt for the best yield of cotton May should be dry, June both warm and dry, and August cool and wet. It has proved possible to predict the yield of cotton more accurately from mathematical analysis of these weather factors than from the reported condition of the crop itself. Mr. T. A. Blair has summarized these and other interesting results of investigations of this sort in a recent article, "The Mathematician, the Farmer and the Weather" (*Scientific Monthly*, October, 1920, pp. 353–361). He points out that careful determination of the heat and moisture requirements of a particular crop during its critical periods, coupled with detailed climatic analysis of a region, will indicate whether or not that crop is climatically adapted to that locality. "Further, there are ways of advancing or retarding, within certain limits, the time of occurrence of the critical periods, thus bringing them into the time when favorable weather is more likely to occur."

Mr. H. A. Wallace in a "Mathematical Inquiry into the Effect of Weather on Corn Yield in the Eight Corn Belt States" (*Monthly Weather Rev.*, August, 1920, pp. 439–446) has recently extended Professor J. Warren Smith's work on the yield of corn in Ohio (see his book, "Agricultural Meteorology," 1920). Mr. Wallace concludes that "the problem of predicting corn yield from the weather is relatively simple in the southern half of the corn belt, notably in Kansas, Missouri and southern Illinois, where drought and heat in June, July and August are the chief influences." In the north, however, as in Iowa and Minnesota, the departures of the monthly means of temperature and rainfall from the average show a disappointingly small correlation with the total yield of corn for each State. It appears that better results would be obtained with the use of the county as the unit of area and by dividing the time into phenological periods rather than into the arbitrary calendar months. Furthermore, it is obvious that along the northern border of the corn belt, an early killing frost might reduce to silage the crop from large areas for which previous weather had indicated heavy prospective yields of grain. Under such conditions only the yield per acre actually harvested for grain could be expected to show any marked relation to the weather previous to the frost.

Some numerical estimates have been compiled by the U. S. Bureau of Crop Estimates (see the *Monthly Weather Rev.*, August, 1920, p. 446) showing the effect of adverse weather on the yields of 12 important crops. In the period 1909 to 1919 the yield of wheat was cut 22.9 per cent by deficient or excessive moisture, by floods, frost or freeze, hail, hot winds and storms; but only 6.9 per cent by the combined effect of plant disease, insect and animal pests, and defective seed. The adverse weather factors experienced reduced the yield of corn 27.7 per cent, while the other factors mentioned took off only 4.4 per cent more. The corresponding estimates for potatoes are 20.7 and 9.3, and for cotton, 22.3 and 13.2 per cent.

CHARLES F. BROOKS

Weather and the Pioneer in Arkansas. An account of "Weather and Crops in Arkansas, 1819 to 1879," gleaned by W. C. Hickmon from Little Rock newspapers and published in the *Monthly Weather Review*, August, 1920, illustrates how large a factor was weather in the life of the pioneer.

The agricultural system of the pioneers at Arkansas Post (Little Rock) was well adapted to the variable weather. The farming was diversified—cotton, corn, wheat, potatoes, truck, fruit and cattle raising—and the uplands as well as the lowlands were cultivated. An average growing season would result in good returns; but, as now, average weather was exceptional. A hot season favored corn and cotton; a cool one the root crops, wheat and pasturage. A wet summer, if not too cool, was fine for corn, potatoes, and cattle; but poor for cotton and wheat. In wet seasons the farmers on the uplands fared well, while those on the river flood plains lost their crops because of floods. When droughts occurred, however, only the lowlands gave fair yields. The early settlers used the Arkansas River as their highway for taking cotton to market and bringing back bacon, flour, provisions,

newsprint, etc.; but low water or ice frequently interrupted trade. When there was high water, on the other hand, the overland mails did not arrive, because of unfordable streams.

The reading of Mr. Hickmon's article impresses one with the familiar succession of unusual storms, floods, snows, and mild winters. It affords a demonstration of the fact that our weather, variable though it is, is essentially constant, a matter of importance in the study of geographic influence.

Charles F. Brooks

SOUTH AMERICA

The Colombia-Ecuador Boundary. The Ecuadorian Government has recently published a document entitled "Arreglo de límites entre las Republicas del Ecuador y Colombia, documentos oficiales" (Quito, 1920), which gives an account of the demarcation

Fig. 1

operations on the boundary with Colombia. This boundary had been defined by the treaty signed at Bogotá on July 15, 1916, and of which ratifications were exchanged on January 26, 1917.

The maps accompanying this document are of peculiar interest, as they are based on trigonometric data and precise measurements, and provide a zone of accurate survey across the Andes in a hitherto unsurveyed section. Unfortunately the quality of the reproduction falls far short of that of the work which the maps represent. The surveys were executed by a joint commission operating in three sections, from the mouth of the Mataje River on the Pacific coast to the watershed between the Napo and Putumayo Rivers.

The boundary commission showed that the definition included in the treaty had been based upon inadequate knowledge of the topography, and found it necessary to make important modifications in a number of places. For instance the line was to follow the San Juan River upstream to the mouth of the Agua-Hedionda valley, and thence up this valley to its head on the Chiles Volcano, and to run from this summit to the source of the Carchi River. The Commission states that the Hedionda valley does not exist, and that the Carchi River has three sources on Mt. Chiles.

The boundary survey has resulted in the fixing of a large number of positions, and in placing the confluence of the Putumayo and Sucumbios nearly sixty miles west of its

supposed position. It has revealed the sources of two east-flowing rivers—Afiladores and Lora, while it has greatly changed the courses of the rivers surveyed. It is interesting to note that the new survey crosses at Tulcán the northern extremity of the chain of geodetic triangulation carried out by the French Mission in measuring the arc of meridian from Payta (Peru) and completed in 1907.

The position of the new boundary is shown on the accompanying sketch map which has been compiled from the maps of the boundary commission. It was apparently considered unnecessary to survey sections where the location of the boundary was not in doubt. Thus there is a gap in the work on the San Juan River, and the southeastern terminal of the demarcated line is the point where the watershed between the Putumayo and the Napo is attained.

While the two Republics are now agreed upon their common frontier, the eastern extremity of this line cannot be regarded as settled until both Colombia and Ecuador come to an agreement with Peru, whose territorial claims in Amazonia overlap those of both countries.

The Coastal Belt of Peru. Fellows of the Society who had the opportunity of hearing Mr. Robert Cushman Murphy lecture on the subject of "The Humboldt Current and the Islands of Peru" will be interested to know of his published results under the title of "The Seacoast and Islands of Peru" (*Brooklyn Museum Quart.*, Vol. 7, 1920, and Vol. 8, 1921). Mr. Murphy's studies are not confined to the habits and distributions of the guano birds but embrace the physical environment and its life relationships. Among the illustrations are eight distributional maps showing either the ranges or the breeding places of various vertebrates, chiefly of the western coast of the Americas. The relative constancy of physical conditions on the Pacific coast is in strong contrast to the periodicity that marks the Atlantic coast and is reflected in two outstanding features: (1) an extraordinary latitudinal range of distribution of groups of animals of far northern and far southern origin and (2) an equally extraordinary abundance of higher vertebrates in littoral waters of low latitudes. These results are closely correlated with the physical conditions, particularly the well-known phenomenon of upwelling sea water along the coast.

Previous to the publication of Mr. Murphy's paper there appeared a paper on the same subject with notes on climate and economic geography (R. E. Coker: "Habits and Economic Relations of the Guano Birds of Peru," *Proc. U. S. Natl. Museum*, Vol. 56, 1920). Mr. Coker points out that while fog and mist are a common feature of the mainland coast during the winter, the offshore islands are practically free from rainfall, so that only upon their higher peaks is there sufficient precipitation to support ordinary vegetation. The result is that "the nitrogen of the guano deposited by the birds cannot become converted into ammonia to be lost by evaporation, but is permanently preserved in a form readily available for the purposes of agriculture." It is pointed out that the absence of rains and storms has a certain effect also upon the abundance of available food and upon the successful propagation of the birds. The correctness of this generalization is tested by finding that nearer the Equator, where the sea breeze is warmer and contains more moisture, light rains are not unknown, as at Lobos de Tierra, in latitude 6.5° S., and here small patches of vegetation may be found and "an inferior quality of guano."

In an appendix Mr. Coker presents a map, reproduced from the *Geographical Review*, showing the location of the Guano Islands. In brief introductory sections the general features of the coast and the character of the Peruvian Islands are set forth and the conditions of the surface water noted. (For a fuller discussion of Peruvian coast temperatures see a paper by the same author on "Ocean Temperatures off the Coast of Peru," *Geogr. Rev.*, Vol. 5, 1918.)

In describing the guano-producing species, Mr. Coker uses the phrase "billion-dollar birds," in view of the fact that between 1851 and 1872 ten million tons of high grade guano were extracted from the Chincha Islands with a pre-war value of three-quarters of a billion of dollars; and in addition there is the value of the guano extracted since that time. In the first years of this century the exports were one hundred thousand tons a year, and in the years 1906–1908 twenty thousand tons of the highest grade were produced.

The main body of the paper is devoted to a detailed description of the chief guano-making birds—their habits, their biological character, the economic importance of each in the general scheme. The most important bird is the cormorant, which outranks all others on the coast in significance as a guano producer and has always had the name of the "guano bird" or *guanay*. In comparatively new guano deposits formed by the cormorant there is

a content of 14 to 17 per cent of nitrogen; in old buried guano preserved from past generations there is a nitrogen content of 12 to 14 per cent, indicating almost perfect preservation owing to the practical absence of rain. As a consequence of the high value of these birds in the economy of Peru, elaborate regulations have been established for their protection—a highly developed form of state conservation.

The closing sections of Coker's paper deal with the relation of sea lions to the birds as enemy and competitor and contain historical notes on the work of earlier observers. The paper throughout contains footnote references of distinct value to the student of the economic geography of Peru.

EUROPE

Studies in City Geography: Edinburgh and Glasgow. Some time ago the Scottish Geographical Society formed a Committee for a National Collection of Old Maps of Scotland. A result of the activity of the Committee is the publication in the Society's magazine of two studies in city geography, Edinburgh (August-September-October, 1919) and Glasgow (January, 1921). In both instances the development of the city is traced from the earliest times, progress being illustrated by a unique collection of maps, views and sketches. The expansion of Edinburgh is admirably summarized in a map in color (scale ½ inch to 1 mile) by the late J. G. Bartholomew. The two studies have in common the fundamental geographical exposition lately defined by Dr. Fleure (Some Types of Cities in Temperate Europe, *Geogr. Rev.*, December, 1920) as the "complex interweaving of environmental influence and cumulative human effort." The method of treatment however is as different as is the history of Scotland's two capital cities: Edinburgh, cultural city and political capital tracing its fortunes to its defensive site on the "well-nigh impregnable Rock" looking eastward over the Firth of Forth; Glasgow, the commercial capital (third city of the British Empire, Calcutta being second), westward-looking with colonial traditions and a present-day fame as the world's greatest shipbuilding center.

Edinburgh is treated by Professor Patrick Geddes from the standpoint of town planning. He discusses shortly what has been done in the way of a civic survey and interprets present conditions in the light of their origins, outlining the growth of the city through ancient, medieval, renaissance, and industrial stages. The city particularly well lends itself as an illustration of his thesis that "each generation, and in this, each essential type, must express its own life, and thus make its contribution to its city in its own characteristic way." At the same time the past makes itself felt. The notorious conditions of squalor and overcrowding in the old city are a legacy from its ancient position as a city of refuge.

Influence of the past in the form of geographical inertia is the theme of the epilogue to the study of Glasgow, a note on the future of the city by Sir Halford J. Mackinder. The point is of basic importance yet is quite commonly overlooked by the student of the "influence of geographic environment." One cannot do better than quote it here.

"It is necessary to invoke momentum from the past in order to explain the greatness of many of the oldest centers of urban life. Geographical analysis alone will not be enough without the inclusion of 'compound interest' on the original geographical capital. You may analyze the position of Glasgow and show that it was founded on the nearest solid ground to a ford across the Clyde, and that the paths up and down the valley here crossed the paths from the hunting grounds of Strathmore and Kyle; but you have so only given the reasons for the placing of a big village. St. Ninian and St. Mungo established a home of missionaries at this focus of pathways into the wild, and so you explain a little episcopal city. Under the protection of her bishops, Glasgow's market outstrips Renfrew, Dumbarton, and Rutherglen, so that the traffic comes by the converging paths from farther afield; you have still only added a High Street of shopkeepers to a cathedral close. The Union of 1707 gives Glasgow the opportunity of importing the sugar and tobacco of Scotland; you have now accounted for Jamaica Street. Finally the exploitation of the Lanarkshire coal and iron gives you an industrial area with a few hundred thousand workers. But Kelvinside and Clydebank, the city of a million within and half a million more without the municipal boundary, is only to be explained by the fact that being a great going concern Glasgow has changed her geographical environment, has brought the seas to her doors and made tributary distant ores and granaries. It is in short an independent geographical fact that you have beside the Clyde not only deposits of coal but in these days also a deposit of human energy and skill and habit of working together. The result is that in a far corner of the

damp and chilly north, in a little sterile land, beside an unnavigable mountain torrent, we see a great world-center. No one would have deepened the Clyde unless Glasgow had already been there. To him that hath shall be given."

This however is not to underestimate the possibilities of the Glasgow region of which in successive times successive advantage has been taken. The development of these latent possibilities is completely traced in the several chapters which include the geographic factor (by Prof. J. W. Gregory), the people, cathedral and bishopric, municipality, port, and overseas relations.

Coal and Iron in the Political and Economic Geography of Northeastern France and Western Germany. The greatest industrial effects to follow the territorial changes required by the successive treaties of peace will take place in northeastern France and

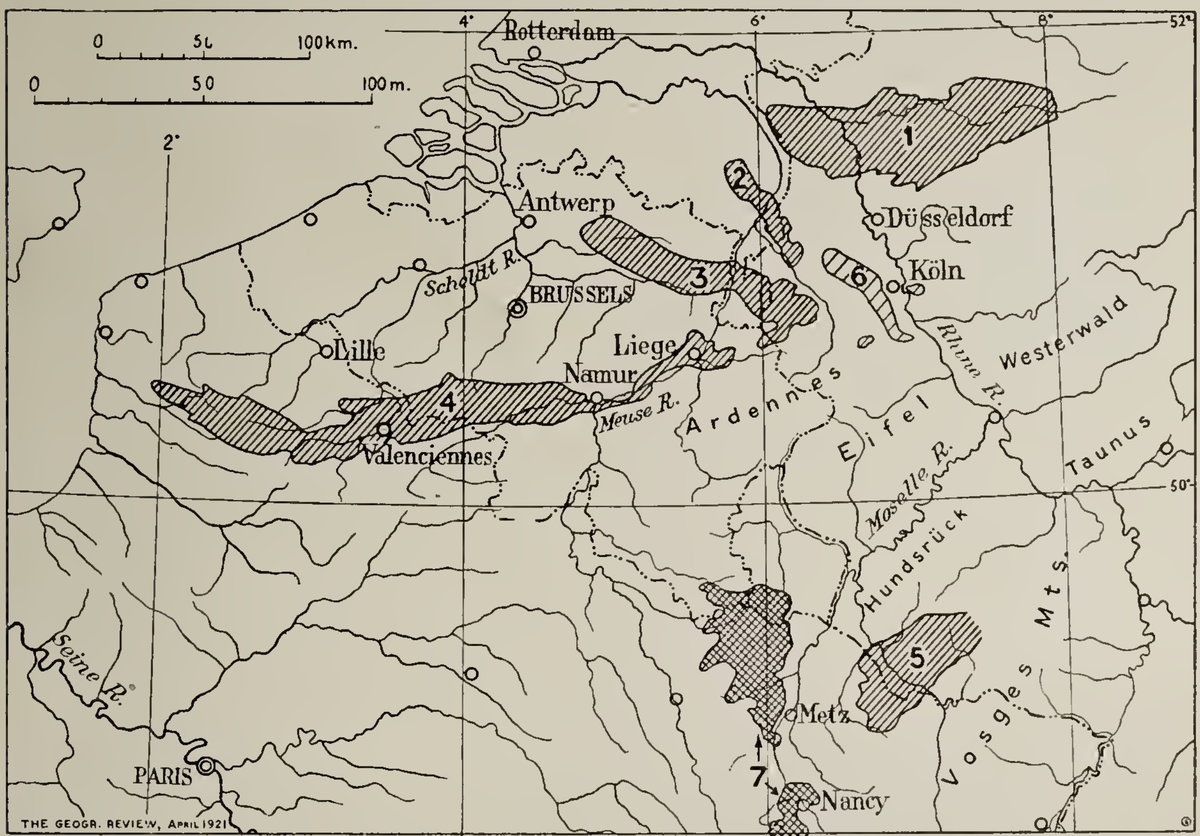

FIG. 1—Sketch map showing the relations of the Lorraine iron ore district and the tributary coal fields. References on the map are (coal fields): 1, Westphalian; 2, Brüggener-Erkelenz; 3, Campine-Aix-la-Chapelle; 4, Valenciennes-Namur; 5, Sarre. 6, lignite field of Cologne; 7, iron ore district of Lorraine.

western Germany on account of the transfer of Lorraine Annexée—that part of Lorraine taken from France in 1871 and restored in 1919. This district contains 48 per cent of the European iron reserves. To detach it from the iron and steel industry of Germany and to add it to that of France is not a simple process. The industrial effects of the transfer of so great a mineral deposit involves the study of the sources of coal and coke which, before the war, were drawn upon in the reduction of Lorraine ore. In addition one must take into consideration the effects that will follow upon the transfer of political control of the Sarre basin during the fifteen years that must elapse before a plebiscite is to determine final ownership. In any case the treaty of Versailles gives France outright ownership of the mines. Thus the political consequences of the treaty and its economic consequences are involved in an extremely complicated manner on the common frontier of France and Germany.

In the study of these consequences as they will unfold themselves in the ensuing decade of economic reconstruction it is of vital importance to know the extent of the *reserves* of iron ore and coal in the several fields; the economic and transportation relations that obtained before the war; and the most economical relation that must be maintained if both France and Germany are not to suffer as a result of the changes in territorial ownership.

Such a study has been made by one of the highest authorities in the country, Dr. Alfred H. Brooks, in a report published by the United States Geological Survey ("The Iron and Associated Industries of Lorraine, the Sarre District, Luxemburg, and Belgium", by A. H. Brooks and M. F. La Croix, *U. S. Geol. Survey Bull. 703*, 1920).

In this brief notice it is perhaps sufficient to characterize the main geographical relations emphasized in the report. In a series of graphs and maps there are presented the geographical relations of the several deposits; the ratio of iron reserves of each country to the total for all Europe; the place of the coke industry in the industrial scheme; the production of coke in France by *départements;* the position and industrial status of the Westphalian coal fields; the part played in German steel production by the Sarre coal field; and finally, the very interesting conclusion that, unless there is an exchange of raw material in the form of the iron ore of Lorraine for Westphalian coke and coal, the economic use of these reserves will be prevented. Political action might in such a case deflect natural economic processes thereby raising the cost of iron and steel production to the disadvantage of "the average European whatever his nationality," besides preventing French and Belgian iron

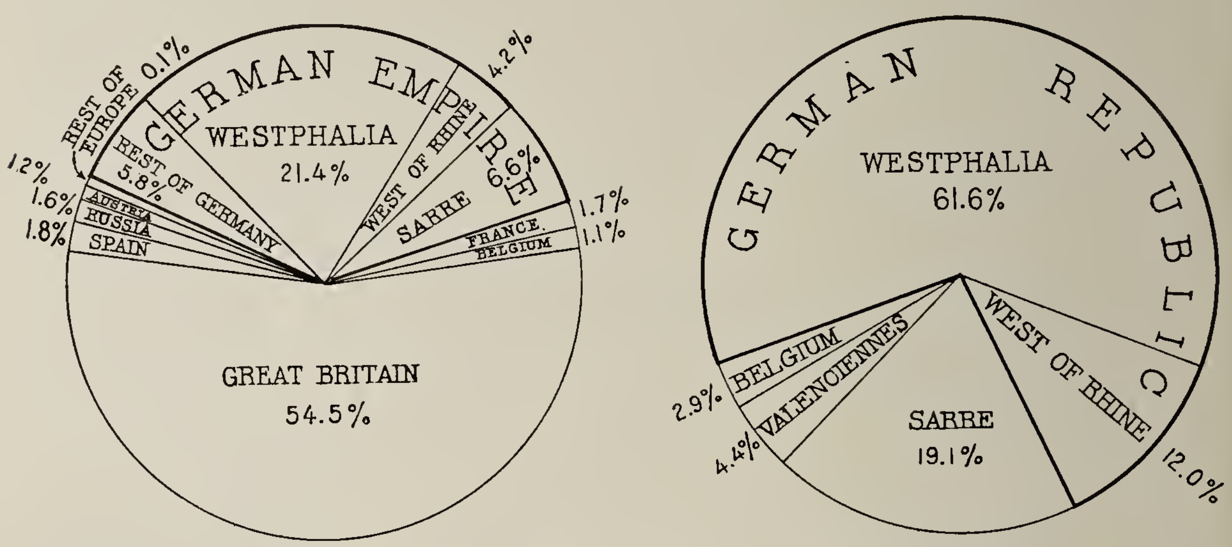

FIG. 2—Diagrams showing percentage of coal reserves: on the left, the national ownership of coal reserves in Europe in 1913; on the right, coal reserves tributary to the Lorraine iron district in 1919.

and steel products from competing in the world market. While the argument is not carried forward into the political field it is easy to apply it to the entire policy of reparations. Thus, along with many other considerations, matters of territory and economic geography bring the thoughtful person back to the question that has been raised in a hundred forms since the treaty of Versailles was signed, as to how far Germany can meet her reparation payments and yet be prevented from reorganizing her economic life along the old lines.

Turning from the general features of the report to the details it may be noted that in no existing publication can one find in such mobile form the facts necessary for a discussion of the problems of economic geography that are posed by the stipulations of the treaty of Versailles respecting Lorraine Annexée and the Sarre. Whether one wishes to study the question of production or transportation; whether one is interested in the question of the sources or that of the dispositions of iron and steel products, he will find the information in practically any desired form. The separate map entitled "Map of Lorraine Iron Districts and Tributary Coal Fields," on the scale of 1:600,000, supplies the geographical outlines of actual producing areas of iron and coal in northwestern Germany from the Westphalia basin to the Sarre, westward to Valenciennes and southward to the Marne-Rhine Canal. While the relief is not shown on the main map it is supplied in a small sketch map (Pl. II) which also gives the features of the main map in less detail. The small map is reproduced herewith omitting the relief, and there is also reproduced a figure showing the national ownership of coal reserves in Europe in 1913 and of the coal reserves tributary to the Lorraine iron district in 1919. The diagrams are accompanied by tables which express the tons of known coal in the reserves and the percentages of the total represented by the principal fields. The total reserves for all Europe in 1913 are given as 248,493,000,000 tons, and the percentages of this total for the different fields have been transferred to the diagram

in redrafting it for the purposes of this note. Percentages of known coal reserves tributary to the Lorraine iron district in 1919 (86,640,000,000) are likewise transferred to the corresponding figure and show in a striking manner the interdependence that must be established between the German coal fields and the French iron-ore fields of Lorraine if either France or Germany is to have a normal industrial life.

Recent Studies of Glacial Variations in the French Alps. Recent studies both in the field and in the archives of Chamonix have furnished a fairly complete history of glacial variations in the French Alps since the close of the sixteenth century. (Ch. Rabot: Les catastrophes glaciairies dans la vallée de Chamonix au xviie siècle, *La Nature*, August 28, 1920). For a long while before 1600 the glaciers on the massif of Mont Blanc were certainly no more and probably much less extensive than they now are. This is indicated not only by documentary evidence but by many old traditions testifying to the former use of passes now impracticable on account of ice. In the first decade of the seventeenth century, however, there began a long age of glacial enlargement that lasted into the nineteenth century. In 1604 advance of the front of the Mer de Glace swept away several houses in the valley and forced the inhabitants of others to abandon their homes. Corresponding damage was done by the neighboring Glacier d'Argentière. An equally destructive "flood" of ice is chronicled between 1609 and 1611, and 1641–1644 was made memorable by the most formidable encroachment of all. A period of minor oscillations then followed until a great advance in 1714, which in turn was succeeded by a gradual but slight recession between 1714 and 1775 and a general period of growth until 1818–1822 when the ice had almost reached its maximum of 1644. "Flood" conditions persisted thence until about 1850, after which there set in that great shrinkage characteristic of the latter 19th and early 20th centuries, which has probably resulted from a combination of three causes: a general rise in temperature, a diminution of precipitation, and an increase in insolation.

Within this broader period of glacial retirement since 1850 there have been two minor advances, one between 1880 and 1890, and the other since 1910 (see the note, "Recent Developments in the Theory of Glacial Variations," *Geogr. Rev.*, Vol. 6, 1918, pp. 75–76). Between 1914 and 1919, inclusive, the Glacier du Tour has advanced an aggregate of 170, the Glacier des Bossons of 171.8, and the Glacier de l'Argentière of no less than 202 meters. Though perhaps on a less striking scale, the same phenomenon has been observed throughout the Alps and is undoubtedly the result of the relatively cool and wet conditions that have prevailed during recent years.

AFRICA

Changes in Population Grouping in the Anglo-Egyptian Sudan. The Anglo-Egyptian Sudan with an area of over 1,000,000 square miles has a population of less than 3,500,000. The relative smallness of the figure is due in part to political events of the last century. Extension of Turkish rule with its ruinous system of taxation into the northern provinces of the Sudan devasted the cultivated areas along the Nile River and encouraged extension of the slave traffic. From Khartum as headquarters the traffic extended up the valley to the Uganda borders. Sir Samuel Baker estimated that at least 50,000 slaves were captured annually during the years immediately preceding 1869, the date of his expedition for its suppression. This work begun by Baker and continued by Gordon was barely completed when the revolt of the Mahdi broke out (1881). Under his régime and that of his successor the Kalifa, war, massacre, famine, and disease cost, according to Sir Harry Johnston, 3,000,000 lives.

The reconquest of the Anglo-Egypt Sudan in 1898 inaugurated an era of peace of which the influence is now penetrating the farthest borders. During the war a source of potential trouble was removed by conquest of the revolting Ali Dinar, sultan of Darfur, and the subsequent incorporation of his semi-independent kingdom as the fifteenth province of the Sudan. The power of British authority was recognized in the picturesque ceremony that took place in London in 1919 when the golden sword of the Mahdi was surrendered to the Imperial Sovereign of the British Empire. Not that the Pax Sudanica is completed. On the remote borders tribal warfare still exists. In 1917 for instance a punitive expedition was sent into the Dinka country east of the Bahr el Gebel to protect the tribute-paying Dinkas from their warlike Nuer neighbors (J. Stevenson-Hamilton: The Dinka Country East of the Bahr el Gebel, *Geogr. Journ.*, Nov., 1920). More recently rebellion broke out

among Dinka peoples west of the river (in Mongalla) during the course of which Major Stigand was killed to the serious loss alike of British administration and African geography.

But the work that has been accomplished in the Anglo-Egyptian Sudan is notable. An illustration of its results is given in a recent number of *Sudan Notes and Records* (April, 1920) by J. W. Crowfoot in his discussion "Old Sites in the Butana." Butana is a "cotton soil" region lying back of the sandstone belt that stretches along the right bank of the Nile between the Atbara and the Blue Nile. It lies on the edge of the "rainland," the annual rainfall according to Peacock's map for 1905–1909 being between 7 and 11 inches (A Report on the Land Settlement of the Gezira, Anglo Egyptian Sudan). Traveling over three hundred miles in the region the author saw scarcely a single built house and very few grass huts, yet there were far more people than had been expected. "We never had any difficulty in finding an Arab *ferik* every two or three hours." All the *feriks* were small, never more than 30 tents and usually only 3 or 4 to 12 or 15. Formerly the tribes moved about in bands 200 to 300 tents strong; "at each halting place the tents were pitched in long rows, and every fifteen to twenty days the drums were beaten, the servants used to strike tents and the whole camp moved to a fresh grazing ground." This is a form of social organization adapted to defensive or offensive purpose. Now that raiding has been put down by the government each family or small group can live by itself. Its smaller flocks can be grazed for months from the same camping ground and it therefore tends to become sedentary, turning more and more to agriculture where soil and water conditions permit. As yet the tent and its equipment have remained much the same as of old, but certain other changes in the nomad economy are in progress. The necessity of meeting the government taxes, the price of security, leads to the regular sale of animals in such markets as Khartum and Omdurman. The surplus cash is expended in the satisfying of new wants and trade grows.

The change from nomadic to sedentary occupation of the region is regarded by Crowfoot as a reversion to a former type. His argument is based on the remains of settlements which flourished in the Meroitic period about the beginning of the Christian era. He believes that there has been "no essential change in the water supply within the historic period," the growth of nomadism being not the result of increasing aridity (in the region itself) but of political factors—invasion from the north.

WORLD AS A WHOLE AND LARGER PARTS

The Decline of Europe. Under the above title Professor Demangeon, of the Sorbonne, has written a small but intense book on the disruptive changes in economic geography that have disadvantaged Europe as a result of the World War. Dealing as he does with inflated values, the disproportion of trading power between the Europe of 1914 and the Europe of today is fictitiously large. This caution must be constantly kept in mind in reading Demangeon's text for while he recognizes the existence of inflated prices he does not and could not make full allowance for them because they are in constant change and their curve of probability cannot be predicted. For example, since the publication of the book, natural remedial forces have been at work and their results have already weakened some of his conclusions. Trading advantages which the United States temporarily enjoyed in South America as a consequence, in part, of our greatly increased shipbuilding activities, have been largely offset by the ensuing lethargy of merchants and government officials and by a rigid credit system which is in unfavorable contrast with the flexible system of British and French bankers engaged in the financing of South American commercial enterprises.

Even if one take into account all of these precautionary principles and facts, Professor Demangeon's book still remains absorbing as to facts and startling as to conclusions. The loss of life in European countries as a direct consequence of the war, the heavy indirect loss of life, the diminished birth rate, the renewed emigration of European peoples to the New World—these are facts of the first order and handicap the European nations everywhere in the revival of overseas trade. Two nations, the United States and Japan, have greatly increased their gold reserves, their exports, their shipping, their foreign agents, and their command over and absorption of the raw materials of industry.

In the case of both Japan and the United States there has been a marked increase in power of commercial penetration in the East Indies and in South America. Japan's imports of raw materials from India and the East Indies are as noteworthy as her recent acquisition

by treaty of special rights and privileges in China, especially in Shantung, and her access of advantage in cable communication and commerce by acquiring a mandate for the scattered island holdings of Germany in the northern Pacific. Her hold upon Manchuria has been greatly increased by intensive methods of control first applied as a part of the process of maintaining a Siberian front against the Bolshevists and later by unfair means of competition in acquiring mining and forestry rights. Tending to still more effective Japanese control of the whole Far Eastern trading realm is her long occupation of Siberia and of northeastern China during the past two years. These changes would have less significance if they represented part of a general prosperity which the entire world enjoyed with normal increase of population and commercial power. But one of the main points of Demangeon's thesis is that they have been gained in precisely that period in which the European nations, preoccupied with war, have lost many of the advantages they once enjoyed; so that even in New Zealand and Australia Japanese goods of almost every variety have been imported in astonishingly large amounts.

The entire story of Europe's relative decline is too long to be detailed here but reference should be made to a publication entitled "Japan: Trade During the War, A Study of the Trade of Japan, Particularly During the Years 1913 to 1917 and with Special Reference to the Trade with the United States," published in 1919 by the United States Tariff Commission. In 1913, 47 per cent of Japanese imports came from Asiatic countries and 43 per cent of her exports went to Asiatic countries. Trade with European countries accounted for 27 per cent of the total and the trade with North and South American countries amounted to 23 per cent, of which 22 per cent was with the United States. The next largest trade was with China, and after that, with British India, each of which amounted to about 15 per cent of the total. In the period from 1913 to 1917 trade with the United States increased more rapidly than that with any other country trading with Japan; and exports of Japanese goods of the classes of "completely manufactured articles" and "partially manufactured articles" rose to about four times the value of exports for 1907 and about 2½ or 3 times the exports for 1913. The increase in the *volume* of commodities imported into Japan from 1913 to 1917 was roughly somewhat over 100 per cent, and the same may be said of the volume of the principal commodities exported from Japan. Whilst the trade of Japan with the United States is of great importance to the former country, it is of less importance to the latter; for in 1913 our total trade with Japan was but 3.49 per cent of the total United States trade and in 1918 this figure had risen to 6.23 per cent. No other American commodities were exported to Japan in 1917 in such quantities as iron and steel, American firms now furnishing about 70 per cent of all iron and steel products imported into Japan.

The value of such analyses as those of Demangeon and of the Tariff Commission will be found chiefly in comparative studies now under way, or to be undertaken, in the long reconstruction period in which the whole world is involved and it will certainly follow that very grave changes in the flow of capital for development purposes and in the exchange of commodities of every kind will take place as a consequence of the unequal burden which the war imposed upon all nations involved in it and the immensely disturbing effect which the war had upon sea-borne commerce of every kind. Only when these comparative studies are available will the actual relative decline of Europe become known. (In this connection see also J. Russell Smith: Influence of the Great War Upon Shipping, *Preliminary Economic Studies of the War*, Carnegie Endowment for International Peace, 1919.)

The World's Copper Production. Under this title Dr. F. H. Hatch gives a short survey of the changes in amount and source of copper production in the last 120 years (*Geological Magazine*, January, 1921). At the beginning of the nineteenth century the world's production was some 15,000 metric tons of which a very large share was contributed by the United Kingdom; the rest came chiefly from Russia (Bogoslovsk), Japan, Chile, Sweden (Falun), Norway (Röros), and Germany (Mansfeld), in the order named. By the middle of the century rapid growth of the engineering trades had raised consumption to about 60,000 tons and new supplies were now being furnished by the British Colonies (Australia and the Cape), the United States, and Cuba. During the next two decades the fairly steady increase in demand was largely met from Chile which country figured as the leading producer in 1870, the United Kingdom occupying second place. From this point onward the outstanding features of the industry are the rapid acceleration of output due to the demand for electric power generation and transmission and the great share contributed by the United States which in 1883 rose to the rank of first producer (26 per

cent of the total of 199,000 metric tons). At this time the output of the United Kingdom had fallen to 1 per cent. At the beginning of the twentieth century the chief producers with percentage produced were: United States (51.5), British Empire (11.5), Spain and Portugal (10), South America (8), Mexico (6), Japan (5), Germany (4.5). During the first decade of the century the total production amounted to 7,333,000 tons. The United

OUTPUT OF COPPER FROM HOME ORES

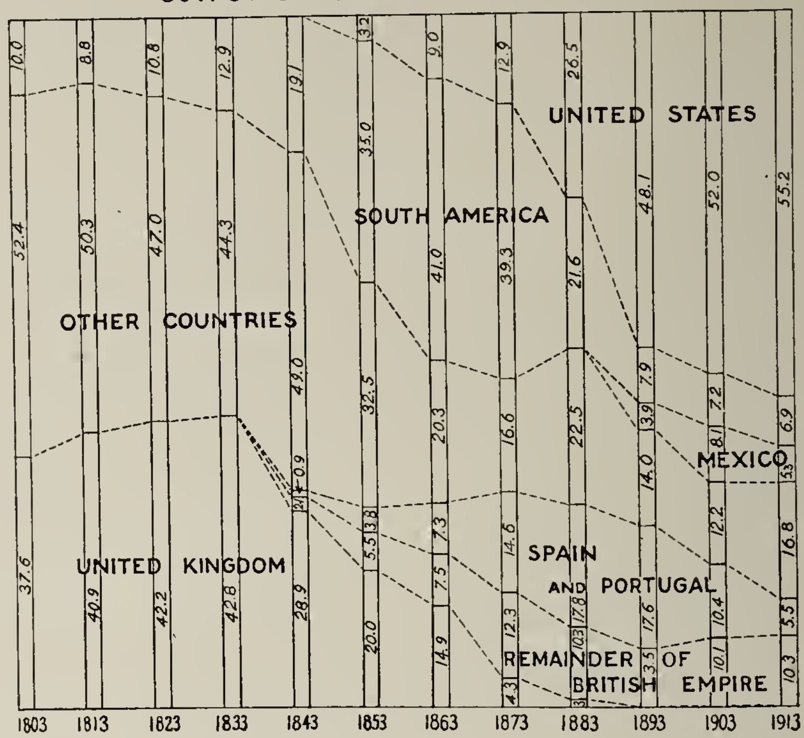

Fig. 1

States, South America, Mexico, and Japan practically doubled their production, and Serbia and German Southwest Africa appeared on the list of producers. It is estimated that the output of the last decade will exceed 10,000,000 tons, or more than the entire production of the last century.

HUMAN GEOGRAPHY

Atmospheric Moisture: Its Significance and Terminology. Not only does great uncertainty still exist as to the real significance of atmospheric moisture, but also great variation in terminology (compare the letter from Dr. Leonard Hill quoted below). As the best means of denoting the relation of water to the atmosphere for the purposes of physiological meteorology, the following terms have all had their advocates: (1) relative humidity; (2) wet bulb temperature; (3) dew point; (4) vapor pressure; and (5) vapor content. Each of these terms holds a distinct and important place in meteorology, and all are closely related. If the temperature of the dry bulb thermometer is given, a knowledge of any one of the other conditions makes it possible to determine the remaining four, provided the relatively slight effect of atmospheric pressure be ignored. Hence in the hands of a skillful scientist it makes little difference which is employed, provided the dry bulb temperature is always stated. For the sake of avoiding confusion, however, and in order to make the matter as simple as possible for the layman who wishes to utilize climatic data for health, pleasure, or profit, it is highly desirable that a single term be employed universally and that this term be one that can be easily comprehended.

As a help in this direction it may be worth while to state my own experience. Till recently I used the term "relative humidity" exclusively. I took pains always to state the temperature and believed that by so doing the possibility of misunderstanding would be avoided. I have found, however, that even climatic specialists both in America and abroad sometimes gain the surprising impression that a certain degree of relative humidity, no matter what the temperature, is supposed to have an importance. On the other hand, a long series

of studies shows that the best health prevails when there is a perfectly definite amount of water vapor in the air. The ideal amount seems to be approximately 5 grains per cubic foot, which is equivalent to a relative humidity of about 80 per cent when the temperature is 64° F. or 60 per cent at 72° F. No matter how high the temperature rises, approximately the same amount of water vapor seems to be desirable, which means that at 90° the relative humidity should be about 35 per cent. A departure from this amount of moisture seems to be attended by discomfort and injury, whether the air be too dry or too moist. Of course a small departure is not particularly harmful, and any condition of the air in which there are present between 3 and 7 grains of moisture per cubic foot seems to be fairly favorable.

At low temperatures the air cannot contain as much as 5 grains of moisture per cubic foot, for at 56° F. that amount of moisture means complete saturation. At 16° F. the air can contain only one grain of moisture per cubic foot. When such air is taken into our heated houses it does much harm to the mucous membranes. For some reason, however, it does not seem to do so much damage when breathed out of doors, perhaps because the low temperature causes a stimulus which partly offsets the bad effect of too little moisture. Nevertheless, the lack of moisture in the cold winter air may be one reason why it often causes discomfort and leads to respiratory troubies even when breathed out of doors. So far as the lungs themselves are concerned the effect of dry cold air is essentially the same as that of dry warm air, for by the time it reaches the lungs it has been warmed. Apparently the lungs are so organized that, when they receive air with 5 grains of moisture per cubic foot, they are easily able to add another 10 grains or so in order to saturate the air after it has been raised nearly to blood heat. If much more moisture is required in order to saturate the air, the lungs are compelled to work under a strain; if less is required, the lungs do not give out enough water to preserve the proper balance of internal temperature, and the body is called upon to resort to other methods in order to maintain equilibrium.

Because of these conditions it seems to me advisable to use the term "vapor content" in studies of the relation of the air to health. This term would have the great advantage of being readily comprehensible to the laymen and of being so definite that neither the layman nor the scientist could well misunderstand it. It is to be hoped that the term "vapor content" may be widely used. I regret that I have not used it hitherto.

Ellsworth Huntington

Dr. Leonard Hill on Ventilation, the Katathermometer, and Humidity. In the April-June number of the *Geographical Review* for 1920 the writer reviewed (pp. 362–363) an important article, "Atmospheric Conditions Which Affect Health," by Dr. Leonard Hill. The writer briefly discussed therein the katathermometer devised by Dr. Hill and the conclusion derived from observations made with this instrument. After the review had appeared a letter was received from Dr. Hill which clarifies several points.

(1) Through a stenographic error it was stated that the method of reading the katathermometer is to take the time required for the mercury to fall from 100° F. to 90°. This should have been 100° to 95°.

(2) Dr. Hill does not believe that the climate of dry hot places, like Jhansi in northern India, is more healthful than that of places that are cooler and moister. He merely points out that such dry heat with rapid motion of the air may cause the "kata" to fall as rapidly as it would in a much more favorable climate.

(3) The further points made by Dr. Hill may best be given in his own words: "You state that the speed at which the kata falls depends upon the temperature of the surrounding air and on the rate of movement of the air. May I correct this statement and say that the rate of fall depends on the loss of heat by radiation and by convection; and that convection depends on the temperature of the surrounding air and on the rate of movement of the air; and that the last factor—namely, the rate of movement—is far the most important, just as it is in the human body."

(4) In actual practice the use of the kata by other than trained workers is not found to be highly complex. "It is very easy to heat the instrument three or four times in succession and take readings of the rate of cooling with an ordinary watch. For ordinary purposes the first of these readings need not be rejected; to divide the average time in seconds into the factor number which is printed on the stem cannot be called a difficult operation, and a table could easily be prepared which would save the observer the trouble of doing this division. I can teach any laboratory boy in five minutes to use the kata."

(5) In regard to the kata as an indicator of the effect of mist, "my conclusion is that it does not show the full effect of the amount of radiant energy of the sun which is absorbed by the skin and the clothes and that the surface temperature of a piece of black fur must be taken in addition to the katathermometer readings in order to evaluate radiant energy."

(6) "The matter of humidity I consider with you of the greatest importance, but I think vapour pressure should be recorded and studied rather than relative humidity. I agree with you that the vapour pressure of the air in winter, which is heated and delivered in your American rooms, being exceedingly low, necessitates your having a much higher temperature in your rooms than we have on this side, and therefore I entirely agree with all you have written about the matter of humidifying the air and so securing a comfortable lower temperature."

ELLSWORTH HUNTINGTON

MATHEMATICAL GEOGRAPHY

Three Early Fifteenth Century World Maps in Siena. In the Palazzo Pubblico, or City Hall, of Siena there is a small chapel furnished with early Renaissance stalls, which were designed possibly by Taddeo di Bartoli and constructed by Domenico di Niccolo

FIG. 1—Tarsia world maps of the early fifteenth century, Palazzo Pubblico, Siena. A little less than half actual size. The shading on the maps indicates the colors of the originals: dark shading represents green, medium represents dark brown, and light represents light brown.

between 1415 and 1428. The back of each stall at about the level of a man's head forms a panel upon which is depicted in colored wooden mosaic, or *tarsia*, a figure, either of God or of an angel. In three of the panels a rough map of the world forms part of the design. In one (Fig. 1, left disc), God holds in his left hand a *mappemonde* about five inches in diameter; it is a typical medieval world disc resembling in its general form and outlines the famous Psalter, Hereford, and Ebstorf maps of the thirteenth century, although no names of places are given. Wood of three colors is used; light brown for the lands, green for the waters, and dark brown—perhaps a faded red—for the Red Sea. As was customary in most medieval Christian maps, Jerusalem is at the center, indicated by a church with dome and towers; the east with Paradise is at the top, and the four rivers of Paradise flow down over an earth encircled by the ocean, penetrated by the Mediterranean and Caspian Seas, and diversified by lakes and rivers. Six or eight cities—simple outlines of houses—are scattered about; also an occasional tree and marks which may or may not be symbolical of mountains, but as the map was the work of an artist and was made wholly for decorative purposes, we are hardly justified in trying to identify its details too accurately.

Another panel illustrates a phrase from the Apostles' Creed: "Factorem coeli et terrae, visibilium omnium et invisibilium." A large figure of God stands with right arm raised directly in front of and partly concealing the world. Houses, woods, rivers, etc., appear clearly on as much of the map as we can see.

The third panel (Fig. 1, right disc) shows a gloomy angel looking at a small *mappemonde*, something like that of the first panel but cruder and less detailed. Jerusalem is again at the center, the mountain of Paradise at the top, and a dark-green ocean encircles the lands. Nine large towered cities add a touch of life.

These little discs are of importance, not so much because of their intrinsic value as maps, as for what they reveal regarding the status of geographical knowledge in their age. They express the geographical views of a typical early fifteenth century artist, probably an alert and fairly well educated man living in a large Italian city. More than a hundred years before, seafaring men were drawing accurate coast charts, or *portolani*, and world maps had already been compiled by the piecing together of the data contained in the charts. But it took long for these new and more correct conceptions to prevail against a theory of the earth's surface which had been built upon a standard interpretation of the Scriptures and which had behind it all the immense authority of the scholarship and tradition of the Middle Ages.

GEOGRAPHICAL NEWS

Joint Meeting of the Association of American Geographers and the American Geographical Society. At the building of the Society on April 21, 22, and 23rd, there will be held the annual joint meeting of the Association of American Geographers with this Society. A preliminary program is in preparation, and will be mailed to all out-of-town Fellows upon request. The final program will be distributed on Friday morning, April 22, and will also be printed in full, with a brief synopsis of each paper, in the July number of the *Geographical Review*. This brief preliminary announcement is made in order that anyone interested may have the opportunity of attending the meeting.

GEOGRAPHICAL REVIEWS

The Atlas of Poland

Eugeniusz Romer. **Geograficzno-statystyczny atlas Polski (Atlas de la Pologne. Géographie et statistique).** 32 sheets of maps with 32 sheets of accompanying text, in portfolio. Gebethner & Wolff, Warsaw and Cracow, 1916. 13 x 14 inches.

The manifold and important services that geography can render towards the clarification of complex political problems have seldom been better illustrated than in the admirable work here under review. This atlas, which was published in the midst of the World War, contains so much dynamite that the governments of the Central Empires long attempted to keep it from passing their frontiers. And not unnaturally, for it is probably the best key that has yet appeared to the understanding of the Polish problem, which, as Prince Lichnowsky once wrote, "was for Germany the gravest question of the war and of the peace." Almost all the chief factors—physiographic, economic, social, and political—that enter into that problem have here been set forth, in so far as maps and diagrams can portray them, with an ingenuity, a technical skill, and a breadth of knowledge and insight that entitle the work to rank as in many ways a model of its kind. Not many countries or territories have yet received so comprehensive and successful a cartographic treatment. For parallels one would have to turn to such works as the atlas of Prussia, published in 1905 as a part of the "Festschrift des kgl. preussischen statistischen Bureaus"; the "Atlas de Finlande," published by the Finnish Geographical Society; the atlas of Asiatic Russia; or Signor Dainelli's recent atlas for Dalmatia.

The present work is a collaborative one, since Professor Romer associated with himself a large number of specialists taken from the foremost ranks of Polish scholars. The statistical material used was extraordinarily rich and in large measure inaccessible to Western scholars, since it came not only from the library of the Austrian Central Statistical Commission but also from the libraries and archives of most of the Austrian ministries, the university library of Cracow, and various private collections.

On first picking up the book, one may perhaps be struck by the immense area included under the name Poland. Is not this another terrible case of "Polish imperialism," a subtle effort to revive the ideal of "historic Poland"? It should be noted that the atlas was prepared at a time when the new Polish state had not yet come into being, and when the only natural thing to do, therefore, was to take for the field of study whatever belonged to the old Polish state—"historic Poland," as it was just before the Partitions—plus certain territories (East Prussia, and Prussian and Austrian Silesia) which had not been parts of old Poland (in 1772) but which have a large Polish population.

The atlas contains seventy maps, large and small, a fair number of diagrams, and explanatory texts accompanying each map. Some of these texts almost approach the dimensions of an essay; most of them are concise but very illuminating résumés of the question in hand. Each discussion is followed by a reasonably full bibliography, the utility of which can be properly appreciated only by those who have tried to investigate for themselves the very scattered and uncharted literature of these subjects. All texts and other explanations are given throughout in the three languages: Polish, French, and German.

The maps and their accompanying texts range over a very wide field: hypsometry, geology, climate, flora; history; administrative divisions; the density and the movement of the population; the distribution of Poles, of Roman Catholics, of Jews, and of the non-Polish linguistic groups; the development of public instruction and of the Polish press; the division of landed property; agriculture, industry, and transportation; savings banks; and many other topics.

When so much has been offered, and in view of the extraordinary difficulty of producing such a work at all under the circumstances of 1916, it seems ungracious to point to such lacunae as may exist. But one hopes that in the future some additions will be made, such as, for instance: a fuller treatment of the agrarian question, with maps showing the distribution of the various types of small holdings as well as of the big estates; maps showing the

electoral circumscriptions and the results of parliamentary elections; and especially a more complete and more detailed portrayal of the distribution of the non-Polish nationalities. Indeed, one may say, and Professor Romer would be the first to admit it, that the ethnographic part is the weakest portion of the book. That was inevitable in 1916, for the authors then had to operate, as far as the largest part of Poland was concerned, with the very unreliable statistics furnished by the old Russian government. It is hardly too much to say that today, after the censuses taken by the Germans and Austrians and later by the Polish authorities in Lithuania, White Ruthenia, and the Chelm region, our ideas as to the extension of the Polish nationality on the east have been, or ought to be, altogether revolutionized.

Limits of space scarcely permit one to dwell upon the multitude of interesting facts that this atlas brings out in clear relief. To allude only to political problems, one will find here a flood of light thrown upon such questions as the comparative results of Russian, Prussian, and Austrian domination; the extraordinary importance that attaches to the outcome of the plebiscite in Upper Silesia; or the relative economic and cultural development of the two nations—Poles and Ukrainians—who have been competing for possession of Eastern Galicia.

A new and amplified edition of the atlas is promised in the near future, in which there will be an English text in parallel columns with French and Polish texts.

Robert H. Lord

The Doctrine of International Waterways

P. M. Ogilvie. **International Waterways: [Part] I, The Evolution of the Principle of International Waterways; [Part] II, A Reference-Manual to the Treaties, Conventions, Laws, and Other Fundamental Acts Governing the International Use of Inland Waterways.** 424 pp.; bibliogr., index. The Macmillan Co., New York, 1920. $3.00. 9 x 6 inches.

G. Kaeckenbeeck. **International Rivers. A Monograph Based on Diplomatic Documents.** With an introductory note by Henry Goudy. xxvi and 255 pp.; maps (in case), bibliogr., index. (Grotius Society Publications, No. 1.) Sweet & Maxwell, Ltd., London, 1918. 15s. 8½ x 5½ inches; case with maps 10 x 7½ inches.

Neither British nor American scholars have given adequate attention to the subject of international rivers. Yet the subject is one of prime importance for students of geography, political economy, and public law. Its intrinsic importance, as well as the dearth of available information, is forcefully illustrated in the discussions of the contemporary peace settlement. Two recent volumes on the subject are timely, and in some respects, at least, they are indispensable.

Part I of Mr. Ogilvie's book is an introduction to the subject of international rights on inland navigable waterways, a subject to be treated systematically in a later volume. This introductory thesis is based on the proposition that freedom of navigation on inland waterways is the natural sequence of freedom of the seas. After preliminary emphasis upon the essential relation between waterways and international communication, the author takes up successively the early development of maritime enterprise, the institution of maritime law, the era of maritime discovery, the struggle for sovereignty of the seas, the freedom of the seas, and limitations upon the freedom of the seas. The concluding chapter suggests briefly the significance of free navigation on inland waterways.

There are obvious difficulties involved in attempting to accomplish so much in so small compass. There is the distribution of emphasis. It is not easy to make a satisfactory combination of original and secondary sources. It is next to impossible to avoid a fragmentary presentation. It is hardly worth while to direct attention to shortcomings of this character in a book such as Mr. Ogilvie has written. The wonder is not that the book has been written indifferently well but that it has been written at all. Perhaps the most serious defect is the recurrence of dubious generalizations. Is it not almost naïve, for example, to assert that the enlightened principle of free navigation was established at the Congress of Vienna? (See pp. 151, 155, 161, 162, 165, 166, 167.) The Congress of Vienna, as Mr. Kaeckenbeeck shows in his volume (pp. 19, 37, 38, 42, 44, 56, 61, 173, and *passim*) was only a preliminary stage in the long struggle against the forces of national particularism.

Mr. Ogilvie seems equally confident that free navigation is established as a principle of international law (pp. 169, 170). But can we safely assert as much without qualification? (cf. Kaeckenbeeck, pp. 20–24, 172). Mr. Ogilvie's book is based upon the premise that freedom of navigation on inland waterways evolved almost immediately from the establishment of the freedom of the seas. But is this premise so obvious and insistent as the author seems to assume? The evidence to be assembled in the later volume will be awaited with interest.

Part II (pp. 172–380) is a reference manual to treaties, conventions, laws, and other fundamental acts governing the international use of inland waterways. The inland waterways of the world are grouped according to continents and are listed in alphabetical order under each continent. Under each waterway the documents are noted in chronological order. More important documents are accompanied by a few select references to secondary sources. There is an exhaustive index.

Mr. Kaeckenbeeck's admirable little monograph is of a different sort. Beginning with a brief but lucid statement of those legal theories and principles which have been enunciated at different periods and applied in developing a doctrine of international rivers—medieval particularism, the Roman Law, the law of nature, the idea of sovereignty, and the conventional system—he devotes the major part of his book to the conventional system and the practice of states. A great mass of treaty provisions and other documents have been examined, carefully analyzed, and presented in the form of a synopsis. The author has been remarkably successful in preserving official texts without sacrificing effective presentation. Materials with reference to the Rhine, the Danube, and the Congo, representing, in the author's opinion, three well-marked stages in the development of the principle of free navigation, occupy the major portion of the volume. Valuable appendixes contain notes on other European rivers and also on the rivers of Africa and America. Mr. Kaeckenbeeck argues for the unqualified opening of all international rivers to navigation by the ships of all nations. He regards the standard regulations approved by the Institute of International Law at Heidelberg in 1887 as the best so far conceived. One slight error may be noted. It is inaccurate to refer to Grotius and Vattel as "two leading representatives of the school of Natural law" (p. 9).

New emphasis upon the problem of international rivers should remind us again of the interdependence between geography and international law. Newbigin's "Geographical Aspects of Balkan Problems in Their Relation to the Great European War" (reviewed in *Geogr. Rev.*, Vol. 1, 1916, pp. 391–392) suggested the futility of any outlook upon international law and politics which seeks to ignore geographical factors. There is the same suggestion, less pointed perhaps, in the books under review. Both Mr. Ogilvie and Mr. Kaeckenbeeck remind us of the limitations imposed by geography upon the inland state as well as the advantages inherent in the position of the maritime state. Thus reminded, we may recall Holland's one-time commercial supremacy based primarily upon a fortunate position at the mouth of the river highway of central Europe, England's insular situation and sea power, Switzerland's landlocked isolation, and Russia's long quest for an ice-free port. There is a dictum in treatises on international law to the effect that all states are in the same position legally, whatever the differences in their respective situations geographically. Will it remain for the geographers to expose the fallacy in this dictum?

Edwin D. Dickinson

The Illinois River and Its Bottom Lands

J. W. Alvord and C. B. Burdick. **Second Edition of Report Made to Former Rivers and Lakes Commission on the Illinois River and Its Bottom Lands with Reference to the Conservation of Agriculture and Fisheries and the Control of Floods.** 137 pp.; maps, diagrs., ills. Division of Waterways, Dept. of Public Works and Buildings, Springfield, Ill., 1919. 9 x 6 inches.

This report, a reprint of the edition of 1915, is a commendable presentation. It is concise, states its findings in a brief and readable summary at the outset, presents its arguments in an orderly fashion, and is not burdened by official reports of subordinates which tend to bury the real issues or which pretend an issue when there is none.

The authors have endeavored to balance the conflicting interests in the valley and, as they have not allowed themselves to become influenced by the propaganda of the advocates of various waterway policies, they have succeeded in reaching conclusions which deserve wide recognition. In terms of wealth production agriculture is the predominant interest of the valley; second to this are the fisheries, and a third function of the river is its use as a waterway. To develop one of these at the expense of another is an unwise procedure which is too often the prominent characteristic of many waterway policies; but to balance the three so that there is sustained as little loss in total wealth as possible is the work of a genius and consequently beyond the reach of most men. To strive towards this end is always possible, and in this particular the present report is superior.

The reclamation of lake areas and overflowed lands by drainage and levee districts appears to be detrimental to the fisheries, which yield 10 per cent of the entire fresh-water catch of the United States (about $750,000); on the other hand, the flooding of the bottom lands appears to be detrimental to agriculture, which promises a yield of about $6,000,000 a year; and, again, the use of the river as a waterway in order to yield its greatest benefit must not have its depth fall below a minimum or have a too full stage which would be destructive, because of wash, to the levees. All these items are given full and fair value in the report, and a constant effort to preserve all the interests is apparent. The policy of flood control, whether by levees or reservoirs, is discussed in the same spirit; and the tables of comparative costs and benefits, while not final, are convincing attempts at serving all the interests affected.

Robert M. Brown

The Negro Problem

M. S. Evans. **Black and White in the Southern States: A Study of the Race Problem in the United States from a South African Point of View.** xii and 299 pp.; map, bibliogr., index. Longmans, Green & Co., London and New York, 1915. $2.25. 9 x 6 inches.

E. B. Reuter. **The Mulatto in the United States, including a Study of the Rôle of Mixed-Blood Races throughout the World.** 417 pp.; indexes. Richard G. Badger, Boston, 1918. $2.50. 8 x 5 inches.

Many people have written on the problem of the negro, but it is doubtful whether anyone has written with a truer balance than Mr. Evans. His "Black and White in South-East Africa" is the standard book on the problem in Africa, and the present book on the United States is equally good. According to Mr. Evans, "The problem of the Twentieth Century is the problem of the colour line." His method of solving it is first that the white man should really know the negro. Hence he traveled through the Southern States to compare our conditions with those of South Africa. "I never once traveled by night, daylight was too valuable. I talked with the men I met on the trains, the roads, the farms, and at the hotels, and I stayed at the homes of both black and white. I visited quays, markets, courts, factories, churches, schools, institutions of all kinds, wherever men did most congregate, and wherever their activities were being carried on." The second point in Evans's method of solving the race problem is the recognition of racial differences. "To assume that the results of geologic time can be swept away, or permanently modified, by a few years' special training, is to place the ephemeral before the fundamental. . . To the believer in the all-sufficient power of education and environment the case is proved by this evidence [of a few imitative natives who have acquired the white man's outer habits], knowing not that beneath the absorbent surface is the adamant of their race genius, formed by gradual accretion from thousands of long-forgotten ancestors."

These sound doctrines are followed by an excellent, but not very encouraging description of the Southern States. In one respect, however, Evans errs. He states that in both South Africa and the Southern States "it has been proved by the experience of nearly three centuries that the climate and conditions are favorable to European family life. The original settlers have increased in numbers by natural reproduction, and their descendants are a vigorous race, mentally and physically. . . It is social conditions, and not the land nor the climate that stand in the way of the best development of the rural South." This is only half true, for the health of the South and of South Africa is far inferior to that of the North and of England; and poor health, especially in childhood, has much to do with the stamina and achievement of a race.

Rarely has the negro been better characterized: "The bulk are of course black; of these we may say that they are, under ordinary conditions, happy and contented, indolent, vain, long-suffering, kindly, intensely social, lacking foresight, unthrifty, imitative rather than constructive, with strong sexual and religious emotions, unrevengeful, with a distinct capacity for fidelity to those they trust. I may add a disposition to accept authority, and to submit to discipline, obedient to their recognized superiors, and evincing an esprit de corps when associated in a mass. . ."

One of Evans's most interesting sections is a comparison of the mountain whites and the negroes. Speaking of the whites, he says: "Here we have a fine basis of race character to build upon. If there is reversion they revert to something good, in the Negro we have constantly to guard against reversion to something worse." Another effective comparison is made between the negroes and the Jews. The Jews come to this country penniless, illiterate, unable to speak the language, and faced by prejudice although not to such an extent as the negro. Today the Jew controls vast financial and commercial interests and even has a large share in the retail trade of the South where negroes are the customers. The negro, on the other hand, whether in Africa or America rarely succeeds in business. He simply lacks the necessary powers of concentration, thrift, and farsightedness. In summing up the progress made since the Civil War Evans says that (1) in agriculture the progress is great and the possibilities immense; (2) in domestic and personal service little progress has been made, and there is no great prospect; (3) in manufacturing and mechanical pursuits there has been progress in certain directions, little in others; (4) in trade and transport there is little progress and little promise; and (5) in the professions progress is being made, and more is possible.

Evans's book is full of passages that one would like to quote. He agrees with Reuter in his book discussed below that the tragedy and the danger of the South is "not the black man whom God made black, but the colored man begotten by the lust of his white father." It is they, with their white aspirations and their black social standing, who keep the race question boiling and render it worse each year. Keep the races apart, make the negroes once more wards of the government, encourage them to lead themselves. "Cherish the gifted of the race, say some. Lift the mass, say I; and in doing so is the true opportunity for the gifted. . . I advocate territorial separation, the conservation of what is good in native life and custom, and the gradual teaching of what they can assimilate from our civilization." Perhaps Evans is right and the United States ought to start a wholly new policy, but our experience with the Indians is not hopeful. The great trouble is that to be successful any policy demands that the negro have white tenacity of purpose and Puritan willingness to sacrifice the present for the future. While Evans's book ought to be read by every one who would understand the negro problem, it is discouraging in spite of his own hopeful attitude.

In the *Geographical Review* for October last there appeared a review of Houghton's book on the Métis or French-Indian half-breeds. The gist of the book was that the "Indians" who have distinguished themselves have been almost wholly half-breeds. By far the best results have come from intermarriages of scions of the French nobility with the daughters of chiefs. In other words heredity is of dominant importance. It is most interesting to find that in Mr. Reuter's book on the mulatto in the United States the general conclusion is the same. The method, however, is so much more exact than in any previous study of this subject that the book may almost be considered the final word.

The first part of Mr. Reuter's book is a straightforward account of the races of mixed blood in all parts of the world and at all times. This is interesting and valuable for reference but contains little that is new. Then follows a discussion of types of mulattoes or mixed races and of their position as the key to the race problem. This leads to the main problem of racial intermixture in the United States. First an attempt is made to estimate the actual number of the mixed types who stand between whites and negroes. For the country as a whole about a fifth of all those classed as negroes are mulattoes, but this proportion varies, being least in the South and greatest in the North and West where negroes are least numerous. The first half of the book ends with a good account of the growth of the mulatto class in the United States, the types of intermixture at various periods and in various regions, and the social status of the mulattoes. Reuter believes that a large part of the mulattoes are the descendants of white men of a decidedly inferior type and on the whole the colored women of the baser sort. Exceptions, however, are very numerous.

The second half of Reuter's book is an accurate and painstaking statistical study of the leaders among the negroes, using the word to include every one who has even a trace of negro blood. From every available source the author procured lists of prominent colored people. Then by means of photographs or descriptions he classified these according to the color of the skin, texture of the hair, regularity of the features, etc. Those who plainly show Caucasian characteristics are counted as mulattoes, the rest as full-blooded negroes. So far as this classification errs, it is on the side of putting too many into the full-blooded group. The final results, as recast by the reviewer, are as follows:

LEADERS OF THE COLORED RACE

	MEN	WOMEN	TOTAL
Black	414	33	447
Mulatto	3,239	581	3,820
Number of mulattoes for one black	7.8	17.6	8.5
Chances of leadership for a mulatto compared with a black	31.2	70.4	34.0

The disparity between the mulattoes and the blacks is enormous. It becomes still more noteworthy when we remember that the mulattoes form only a quarter of the total colored population. On that basis the chances that a mulatto boy will become a leader are 31 times as great as those of a full-blooded black boy, as appears in the last line of the table; while the mulatto girl has 70 times as much chance as her dark playmate. The disparity is even greater when the more exacting professions are considered. For example, for doctors and dentists, whose profession requires at least a modicum of training, the ratio becomes 60 to one in favor of the mulatto. For preachers, on the other hand, where almost no training is required, it is only 20 to 1. "The higher the standard of success, the lower the per cent of full-blooded negroes." In addition to all this in considering these 4,000 colored leaders it must be remembered that "the Negro in America has not yet produced an individual entitled to rank among the world's geniuses. Kelly Miller (himself a Negro) has said that, judged by European standards, the race has produced no men of even secondary rank. Mr. Du Bois (another leading colored man) would seem to agree that this is a fair statement of fact."

Reuter's whole book is extremely discouraging to those who believe in the capacity of the negroes for growth. No matter how great the allowances one makes, the fact remains that white blood is generally needed in order to insure even moderate success. Reuter draws no broad conclusions, he largely confines himself to facts; but his book forces the reader to draw conclusions. It comes nearer than any previous book to a dispassionate answer to the question of the innate abilities of the negro race.

ELLSWORTH HUNTINGTON

SWEETSER'S GUIDE TO THE WHITE MOUNTAINS

M. F. SWEETSER. **A Guide to the White Mountains.** Edited and revised by John Nelson. xv and 387 pp.; map, ills., index. Houghton & Mifflin Co., Boston and New York, 1918. $2.75. 6½x 4½ inches.

"Sweetser's White Mountains" was a successful and important guidebook in the Concord coach period of summer hotels, at its height in the early eighties. It was so lavish of information, so garrulous, that early editions seem now to have value as documents in social history as well as in geography. It is interesting therefore to examine the result of an attempt to adapt it to the motor period. Taking the book first as it stands; the only map is of the railroad folder type, negligible and full of errors; no hint is given as to where maps may be obtained. There are numerous errors in the text—not surprising if, as seems probable, the editing was largely a one-man job. Accuracy in a guidebook is impossible without the help of those who have special knowledge. Taking only the region as to which the reviewer is a "specialist," the view mentioned on page 274 (small type) is the view from the South Slide, not the North; on page 288 it is stated that the peaks of the Acteon Ridge

are well seen from the Sandwich Mountain path; the path which gave this view was superseded and abandoned over thirty years ago. The descriptions of views from summits were not revised very thoroughly; for instance, Berlin, N. H., as seen from Mt. Washington is no longer the "white hamlet" of the description written forty years ago.

As to the method of revision, the preface states that much information available elsewhere has been omitted, namely, as to railroads, hotels, motor routes, detailed trail descriptions, history, botany, geology—"the new edition must confine itself to the functions of a modern guidebook." What are they? The reviewer believes a guidebook should supply regarding the region concerned all the information that can be packed into a volume of "handy" size, omitting *en bloc* only data already available in some other up-to-date and convenient publication. Testing this guide accordingly, for detailed trail descriptions the tourist is referred to the A. M. C. Guide—accepted as handy and up-to-date; for roads he must get the Blue Book—a bulky volume, entirely without information as to side roads; for railroads and hotels he must accumulate advertising pamphlets, consult the bulky Blue Book, and do without disinterested help; for history, botany, geology he must be content with out-of-date editions of this guide or hunt the scattered material for himself. The new edition contains no bibliography.

This method is largely a mistake. Condensed information as to railroads, roads, and hotels should be included—more or less in the Baedeker manner. It was probably wise to retain the long descriptions of views from summits, but tourists wish to know more than the names of distant peaks. The history of the region should be treated from a broader viewpoint; the biological and geological character should be sketched in from the latest studies, with glimpses of the work of glaciers and the life struggle at timber line; the economic history should have a word, with suggestion of the change from farming and trapping to hotel keeping and lumbering. Finally, much of the otherwise acceptable descriptive matter needs further revision to eliminate Victorian phraseology; and if the whole could be edited by one with a command of vigorous and vivid English it would add much to its popularity.

Nathaniel L. Goodrich

A Journey on the Arctic Coast of Alaska

Hudson Stuck. **A Winter Circuit of Our Arctic Coast: A Narrative of a Journey with Dog-Sleds Around the Entire Arctic Coast of Alaska.** x and 360 pp.; maps, ills., index. Charles Scribner's Sons, New York, 1920. $6.00. 9 x 6 inches.

This is the late Dr. Stuck's fourth book of Alaskan travel, and we are indebted to him for all he has written. He is a keen and a painstaking observer with a literary gift that has added much to the attractive quality of his writings. This last book describes his journey westward from the Porcupine River (Fort Yukon) to Kotzebue Sound and then north and eastward along our entire Arctic coast to the north of the Arctic Circle. It was a bold undertaking carried out in the exceedingly cold winter of 1917–1918. Temperatures were down to −63° in the interior but were somewhat less severe along the coast. When the small party had to spend the night in tents, at such very low temperatures, there was no comfort and little sleep; and none but the hardiest of white men could long endure it. The mean official temperatures for December and January on the Yukon were the lowest recorded in twenty years.

Dr. Stuck gives a vivid picture of Eskimo life along the coast, discussing the influence of white civilization. He denounces the government policy of permitting salmon canneries to be established at the mouth of the Yukon, thereby depriving the northern natives of much of their natural supply of food. Under this condition, he says, the government must either feed the natives or let them starve.

Among laws imposed upon the natives which Dr. Stuck regards as unwise is one requiring a license before any marriage may be solemnized. The nearest commissioner who can supply a license may be 200 to 300 miles away, and often a license cannot be procured for two or three months. Consequently the natives revert to the old state of things and live together anyhow.

Further he thinks it is not creditable to our government that on the whole Arctic coast of Alaska there is only one physician and not a nurse or a hospital. Our government is

making successful efforts to provide elementary education, but this does not excuse it for the almost total neglect of the health of the Eskimos.

On the contrary, as is well known, the importation of reindeer has proved a great success. Congress appropriated $300,000 to buy them; and their progeny, now in Alaska, are estimated to be worth $3,000,000.

The author's circuit is shown on an outline map of Alaska. He also reproduces Leffingwell's map (*U. S. Geol. Survey Professional Paper 109*, 1919) and pays tribute to the fine work that Leffingwell accomplished in the careful triangulation of this northern coast, "for which he must always be remembered in the annals of geography."

Cyrus C. Adams

History of the Biogeographical Problem of Discontinuous Distribution

Nils von Hofsten. **Zur älteren Geschichte des Diskontinuitätsproblems in der Biogeographie.** Index. Reprint from *Zool. Annalen*, Vol. 7, 1916, pp. 197–353. Würzburg.

This essay on the theories of the discontinuous distribution of plants and animals is limited to the living world and does not consider the life of the past ages. The presentation is clearly and interestingly written by a biologist along historical lines. It begins with the theories of the Greeks as set forth by Hippocrates and Aristotle, who thought the distribution to be due to differences in the local climates, and follows the more essential ideas down to the present time. For a while the church stimulated this research because of the riddle of the wide distribution and variability of man, but in the end it fought the conclusions of the naturalists.

Modern views began with the discovery of America, with its plants and animals which are different from those of Europe. Some continued to explain this difference by special local creations, and in fact Louis Agassiz (1850–1859) held to the creation theory to the end of his life. Buffon (1749–1756) is sometimes regarded as the originator of modern views in regard to biogeography. The way was further indicated by Cuvier (1815), Lyell (1830–1833), Heer (1845), and Forbes (1846) and was modernized by Hooker, De Candolle, Darwin, and Wallace. Now we know that the organisms are where they are because of local genetic developments out of antecedent stocks, conditioned by their variable dispersion and evolution along varying routes of travel and climate, and that this variation was brought about in the main by the geologic changes in the configuration of the land surfaces and their oceanic boundaries.

Charles Schuchert

Rock Structure and Landscape Form

Karl Sapper. **Geologischer Bau und Landschaftsbild.** vi and 208 pp.; ills., index. *Die Wissenschaft*, Vol. 61. Friedr. Vieweg & Son, Brunswick, 1917. M. 7.20. 9 x 6 inches.

This semi-popular book, the outgrowth of lectures delivered in 1916, is the work of an experienced explorer in tropical America, Australasia, and elsewhere, who was professor of geography at the German university of Strassburg for several years up to the end of the war and who was then transferred to Würzburg. The first half of the book discusses the interaction of underground structures and surface processes in the production of the manifold landscapes of the earth; the second half is occupied with generalized descriptions of various types of landscape as affected by climate.

The first half is novel in some respects, as in giving in the introductory pages brief accounts of the odors and sounds that are associated with certain landscapes and in detailing the changes of landscape appearance under varying illumination, as at morning, noon, and evening, in clear and in stormy weather, in winter and in summer. The motive here seems to be to call attention to items that are commonly overlooked. But when we read in one passage that the chief source of illumination is the sun, by which the moon as well as the earth is lit up; in another that the change from day to night affords the maximum contrast of light and darkness; in a third that among other sources of terrestrial illumination are the aurora borealis, volcanic eruptions, lightning, and prairie fires (shooting stars are omitted); and in a fourth that fireflies and burning natural gas are generally too faint

to light up the landscape, the question arises whether the enumeration of such matters is a mark of originality and profundity or merely of perseverance.

The systematic discussion of landscapes divides their elements into inorganic and organic groups; but instead of the natural order of arrangement which assigns first treatment to the inorganic elements, because they constitute the environment in which most of the organic elements have their being, we find the organic elements are here given precedence. Perhaps as a result of this order of presentation, organic forms are not clearly treated as conditioned by the inorganic; there is not sufficient emphasis given to the relationships that exist between the earth and its inhabitants, although such relationships are of the highest significance in actual landscapes. Instead, various relatively trivial items are here again instanced, such as the spray spouted by whales at sea. The harmless statement that "Perhaps nothing affects the beauty of a landscape more than vegetation" is regarded as of sufficient originality to be credited to its author, Masius H. Wagner, who is quoted as having calculated (he must have had much time to spare) that if the plants of the earth were evenly distributed over its entire surface they would form a layer 4.4. mm. in thickness, to which the animals would add 0.5 mm. But no reference is made to the important studies made by American and other ecologists concerning the slowly flowing adjustment of floras and faunas to the gradual change of surface forms in a down-wearing land area, although the principles thus established are as beautiful as they are significant. Surely these principles are more important than Wagner's calculations; they cannot be omitted if landscapes are to be appreciatively studied.

In the chapters on land forms, the attempt is made to treat them in a broad philosophical manner. Constructional forms are first described, and the effect of erosion in modifying them is then introduced; but the discussion is so incomplete that few clear ideas can be gained by readers not already familiar with the subject. As if conscious of this deficiency, the author offers a delusive excuse for not assuming fuller responsibility for an explanatory treatment; namely, that the book is not concerned with theoretical analyses. But in reality the results of theoretical analyses, and for the most part of good analyses as far as they go, are found on many pages. For example, in treating of the transformation of initial forms of disorderly structure into their derivatives, the author points out that, even after the down-wearing of such masses to an almost level surface, the direction of rivers and of "many other features" will still reveal the attitude of the underlying rocks (p. 57). Exception need not be taken to the manifestly theoretical nature of this statement, but only to its vagueness, for inquiring readers will be dissatisfied not to know how it happens that river courses on worn-down surfaces indicate underground structure, and not to know what kinds of other features give similar testimony.

The more serious aspect of Sapper's delusion as to his method of discussion not being theoretical is that, like those untrained "practical" persons who complacently assure us that they do not theorize, he fails to distinguish between safe and unsafe theoretical conclusions. Thus reference is made to the plains of Russia (p. 43) as if they departed from their initial form only by the incision of valleys, and the Jura mountains are cited on three different pages (pp. 33, 46, 49) as if they were but little modified by erosion since their folding; yet evidence has been brought forward, by Philippson and Brückner among others, which shows that both the Russian plains and the Jura anticlines are now in a fairly advanced stage of a second cycle of erosion, following peneplanation in an earlier cycle. In spite of the title of the book, its first half, in frequently failing to give the reader a clear understanding of visible land forms, does not embody the essence of what Passarge very well calls *Landschaftskunde*, "a new branch of geography that has at last secured for itself the place that it should have taken long ago" (Beschreibende Landschaftskunde, 1919, p. 1).

Another curious characteristic of Sapper's method is a mistrust of the indispensable mental faculty of deduction as an aid in reaching an understanding of land forms. The mistrust is expressed in several homilies, which intimate that not enough is yet known about the manner of action of various external processes upon various underground structures to make it possible in all cases to use the deductive method safely. There cannot be two opinions about these "safety first" generalities, for physiographic research has surely not yet solved all its problems. For that very reason the important thing for every physiographer to do is to try to carry forward the investigation of land forms, inductively and deductively, toward more and more assured results.

The negating quality of treatment exhibited in the unsuccessful effort to exclude theoretical analyses and deductive explanations is encountered again in an attempted exclusion of

explanatory terms, that give indication of the origin of land forms, in favor of neutral terms that give no such indication; yet frequent use is made of such terms as volcano, landslide, moraine, and various others which have the origin of the forms that they designate embedded in them. And a similar negating quality is seen in the condemnation of block diagrams because, as vegetation is ordinarily not indicated upon them, they might be taken to represent desert landscapes; yet no unfavorable comment is made on the use of mere profiles or structural sections, such as are found in Richthofen's "Führer" or in Penck's "Morphologie," although such figures are much less helpful to the uninformed reader than even rudely drawn block diagrams, in which structure, profile, and surface are all indicated. Sapper solves the diagram question for his own book handily enough by having no diagrams at all, thus leaving his readers to make out his meaning from the text alone as best they can.

As already noted, the second half of Sapper's book, which describes eight climatic types of landscape, is easier and better reading than the first half, because the author here presents for the most part general descriptions, in which he succeeds, and gives but secondary attention to systematic explanations, for which he is apparently less qualified. The eight types are: humid tropical, open tropical, subtropical desert, moist temperate, dry temperate, high mountains of middle or low latitudes, subpolar and polar, and sea and coastal landscapes. The examples presented are well chosen, but the implication that certain classes of structure are associated with certain types of climate may mislead the reader. Here, as in the first part of the book, it is curious to note that, with very few exceptions, no authors or observers other than Germans are cited. Whether this is because the university library at Strassburg was poorly stocked with geographical books, or whether it is a consequence of nationalistic introspection during the Great War cannot be told.

W. M. Davis

The Physiological Effect of the Air on the Human Body

C. W. B. Normand. **The Effect of High Temperature, Humidity, and Wind on the Human Body.** Diagrs. *Quart. Journ. Royal Meteorol. Soc.*, No. 193, Vol. 46, 1920, pp. 1–14 (discussion, pp. 12–14). London.

The deadliness of the simoon has long been a source of speculation, but now the question appears conclusively solved. It is neither the high temperature alone that kills nor the strong dust-filled wind that suffocates, but the two in combination, which brings more heat to the human body than it can lose even though exerting its maximum powers of providing for evaporation. The author presents a detailed discussion of the katathermometer with a wetted surface and of the ordinary wet-bulb thermometers as indicators of possible limits of human life under different conditions of temperature, humidity, and wind velocity. The wet-bulb thermometer constantly supplied with moisture is taken as the better index of human responses. With a certain maximum rate of provision of moisture for evaporation there comes a limiting temperature above which, no matter how dry the air is, the temperature of the wet bulb can no longer be maintained at blood heat by evaporative cooling. The stronger the wind, the lower this limiting temperature is. As there is a limit to the amount of water the human body can supply for evaporation in a given time, the stronger the wind, the lower must be the air temperature if weather conditions are not to prove fatal.

On a calm day 120° F. may be easily endurable under the conditions of extremely low humidity characteristic of a desert in daytime; but if a simoon comes on, even though the wind may actually reduce the temperature by mixing the heated surface air with cooler air above, the air becomes fatal. However, if the face, hands, and feet are buried in the clothing, and the simoon does not last over an hour or two, the reduced wind velocity at the skin and the slow rise of temperature due to body heat and conduction may prevent fatal body temperatures being reached.

Among a group of men some will get heat strokes much sooner than others. This is due to physiological differences and also to local effects of clothing. Heat strokes may come from unbearable heat and humidities over portions of the body poorly ventilated on account of clothing, or through exhaustion of the sweat glands, or derangement of the bodily heat regulatory apparatus.

Charles F. Brooks

First-Hand Impressions of Japan

J. I. C. Clarke. **Japan at First Hand.** xxxvi and 482 pp.; ills., index. Dodd, Mead & Co., New York, 1918. $2.50. 8½ x 5½ inches.

Mr. Clarke writes with an attractive style and comes to his task in a sympathetic attitude and with a mind open and impressionable.

He sees the beauty and feels the charm of that picturesque land, studies its quaint and curious customs, and redraws for us delightful pictures of Japanese peasant life—the fishing village, the rice planting, the tea picking, the cherry blossom festival, the geisha girl, and the *Nō* dance.

He also writes of modern Japan. Referring to the cotton spinning and weaving, he says that "the industry is immensely profitable, earnings up to thirty per cent being constantly reported." "Cheap and abundant female labor," he declares, "accounts for much of this."

Some hint is given of the very unsatisfactory conditions that prevail in the factory life of Japan. In some of the better sort of factories an attempt is made to look after the welfare of the workers, but the conditions on the whole are probably the worst in the factory world. Out of a million of workers 73 per cent, we are told by one student, are female—mostly girls under 20 years of age—and children. The hours range from 11 to 14 a day. Mr. Clarke states that "in most mills work is practically continuous, a night force and a day force changing ranks at intervals." "On the whole," says Mr. Clarke, "the system leaves much to be desired. It was surely corporate greed which in peace time made all-night work take up half the women's time in a year. It doubled the capacity of the plant, but it halved the vitality of the workers. . . And the wage is so small that an American or even an English factory hand, even a French or German worker, would laugh it to scorn." Mr. Clarke does not mention it, but the fact may be stated that legislation designed to improve factory conditions has been held up by those interested in the profits of these factories, who also control the government.

Attention may be called to the chapter on "Parliament and Politics in Japan," wherein we are reminded of the fact, now pretty generally known, that Japan "is still in the rear of pure representative government." Although Parliament may pass laws, "the date of their promulgation is reserved to the Emperor." Instead of "Emperor" we should substitute "the oligarchy that advises the Emperor."

The administration of the government in Korea the author seemed to find conducted in the interest of the natives. Other reports do not agree with this. There can be no doubt that Japanese rule in Korea is more efficient than that of the Koreans, but the question still arises: Is the principle of the self-determination of peoples one to be recognized in shaping the policies of government? Probably we shall have to answer this question in the near future in deciding the destiny of the Philippines. It can scarcely be denied, however, that, if there are any treaties that have been made "scraps of paper," those relating to Korea deserve a place at the head of the list.

E. T. Williams

Cotton in British West Africa

N. M. Penzer. **Cotton in British West Africa including Togoland and the Cameroons.** With an introduction by Viscount Milner. 53 pp.; maps, bibliogr. The Federation of British Industries, London, 1920. 5s. 9½ x 6 inches.

The Federation of British Industries, an organization whose purpose is the fostering of increased production, especially of raw materials within the Empire, is issuing a series of monographs on the most important of these materials the supply of which affects the prosperity of the Empire as a whole. The present study is the second in this series, one treating of "Rubber in Malaya" having already appeared.

This memorandum, though brief, is of value for three things; its geographical description of the regions concerned, including the late German colonies and the Lake Chad district—all from a fresh viewpoint, that of the possibility of cotton culture as affected by soil, climate, labor, and transportation; its recognition of the influence of such economic factors as cotton raising upon international relations; and, by no means least, the very full bibliography that accompanies the text, in which may be found, arranged chronologically, practically all the important treatises on cotton and cotton culture, from 1881 to 1920.

The Basin Region of Iran: Morphology and Climate

Oskar von Niedermayer. **Die Binnenbecken des Iranischen Hochlandes.** 59 pp.; map, diagrs., ills., bibliogr. Munich, 1920. 9 x 6½ inches.

The paper is based on a journey of scientific exploration (wissenschaftliche Forschungsreise) in 1912–1914 and on a twofold crossing of Persia and Afghanistan (the object and route of which are not stated) during the "war years" 1915–1916. The text begins with a brief description of the general tectonic characteristics and geological formation of what the author calls the "highland" of Iran, but which others call the "basin region." Difference in altitude between the edges and depressions is discussed, and then comes a long and excellent section on the present climate. A page or two is devoted to the rivers, and then follows the main body of the work, a series of sections devoted to a generalized description of the basins, with examples to illustrate details.

Good descriptions are given of the gravelly wastes on the edges of the basins, the deposits of sand, clay, and salt in their lower portions, the terraces which surround the old lake beds, and the peculiar breaking of the saline lake deposits into polygons. An excellent feature is a classification of the basins according to their stage of development, first genuine salt lakes, then temporary lakes, next swamps, and finally mere flat-floored depressions which are never covered with water.

The last quarter of the text is devoted to the question of climatic changes. Niedermayer agrees with practically all previous students of the problem as to the great change that has taken place since the glacial period but is sceptical as to a progressive change of climate during historical times. The reviewer's work on "The Basin of Eastern Persia and Sistan" (pp. 219–317 of "Explorations in Turkestan, with an Account of the Basin of Eastern Persia and Sistan, Expedition of 1903, under the Direction of Raphael Pumpelly," *Carnegie Instn. Publ. No. 26*, Washington, D. C., 1905) is taken as typical of the hypothesis of progressive climatic change and comes in for a good deal of criticism, all of which is reasonable and friendly. The chief arguments against the hypothesis are the old familiar statements that rivers change their courses, irrigated fields become saline and must be abandoned, wars produce devastation, and bad government works havoc. All of this is true but has no bearing on the question of whether the present total water supply is sufficient to support as large and prosperous a population as we know to have existed in Persia and its neighboring countries in past times. As a final argument Niedermayer states that the reviewer must be wrong because he does not take due account of periodic changes such as Brückner has found in the Caspian Sea, nor of a dry period in post-glacial times. Hence his final conclusion is that "in Turan as well as in Iran great changes have taken place in the conditions of precipitation; whether they are nonperiodic or periodic we do not yet know, and if the latter we shall not soon learn the length of the period, since in any event they are clearly longer than the 35-year Brückner period." This is interesting, for it is exactly the conclusion reached by the reviewer in "The Pulse of Asia" and amplified in "Palestine and Its Transformation," "The Climatic Factor," and "The Solar Hypothesis of Climatic Changes." If Niedermayer had kept track of the literature in English on his main subject (it should be remarked that the bibliography of 93 titles includes only three non-German works published since 1907), his paper would presumably have been quite different. It may be, however, that his independent conclusions as to the instability of post-glacial climates are more valuable than if they had been influenced by the work of others.

Ellsworth Huntington

CORRESPONDENCE

Boston, Massachusetts, December 18, 1920

To the Editor of the "Geographical Review":

My attention has been called in a letter from G. H. Knibbs, Esq., Commonwealth Statistician, to an error in my review of Sir Timothy A. Coghlan's "Labour and Industry in Australia from the First Settlement in 1788 to the Establishment of the Commonwealth in 1901" in the *Geographical Review* of last April-June. Mr. Coghlan, while at the head of the Statistical Department of New South Wales for many years, did not bear the title of

Registrar-General. The act creating the present Commonwealth Statistical office was passed in December, 1905, I understand, after Mr. Coghlan had ceased to deal with Commonwealth statistics, and before the *Commonwealth Year Book* was published. He was editor of a preceding publication known as "The Seven Colonies of Australia." I am informed through correspondence from the Commonwealth Statistical Office, that "Sir Timothy Coghlan had no part directly or indirectly in the collection and scheme of work in this Bureau, nor did he ever edit or publish the *Commonwealth Year Book*." Credit for the present organization of the Commonwealth Statistical Office and the *Commonwealth Year Book* is due exclusively to Mr. G. H. Knibbs who has been Commonwealth Statistician since the Bureau was organized.

Very truly yours,

VICTOR S. CLARK

Ann Arbor, Michigan, February 7, 1921

To the Editor of the "Geographical Review":

On page 138 of the January number of the *Geographica Review*, O. E. Baker makes the statement that Nashville, Tenn., is the second city of the United States in the number of persons mentioned in *Who's Who:* also that Boston-Cambridge stands at the head. I find on referring to the lists of names in the back part of *Who's Who* that the author of this statement is poorly informed, except perhaps in the matter of Nashville being the Athens of the South. The Athens of the United States seems to be Urbana, Ill., while Ithaca, N. Y., and Ann Arbor, Mich., stand second and third if percentage of population listed in *Who's Who* is a test. The following table presents the essential data for the several educational centers:

	POPULATION	IN "WHO'S WHO"	RATIO
Urbana	10,230	102	1:100
Ithaca	17,004	123	1:138
Ann Arbor	19,516	101	1:193
Madison	38,378	158	1:243
Evanston	37,215	144	1:259
Berkeley	55,886	164	1:340
Cambridge	109,456	302	1:362
Boston	747,923	996	1:751
Nashville	118,342	111	1:1066

Very truly yours,

FRANK LEVERETT

THE GEOGRAPHICAL REVIEW

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PUBLICATIONS OF THE AMERICAN GEOGRAPHICAL SOCIETY

Periodicals

Bulletin of the American Geographical Society, 1852-1915. Fifty-one volumes. Known as *Bulletin* (1852–1856), *Proceedings* (1862–1864), *Journal* (1859–1860, 1870) *of the American Geographical and Statistical Society*, and as *Bulletin* (designated *Journal*, however, on title page of bound volumes to 1900) *of the American Geographical Society* (1872–1915). Generally quarterly to 1903; monthly, 1904–1915. The volumes for the following years are available at $1.00 each: 1871, 1872, 1874, 1876, 1878–1905 inclusive, 1908, 1915. A set of the *Bulletin* from 1859 (complete except for four volumes that lack individual numbers) may be obtained for $150.00.

Index to the Bulletin of the American Geographical Society, 1852-1915. By Arthur A. Brooks. With an historical and bibliographical note and a table showing the arrangement and composition of the series. xi and 242 pp. $2.00.

The Geographical Review, Vols. 1–11, 1916 to date. Successor to the *Bulletin of the American Geographical Society.* Monthly, 1916–1920; quarterly since 1921. Monthly numbers, 50 cents; quarterly numbers, $1.25; unbound volumes, 1916–1920 (two a year), $2.50; from 1921 (one a year), $5.00.

(**Annals of the Association of American Geographers,** Vols. 1–10, 1911 to date.) Organ of the Association, but distributed and, since 1913, published by the Society. $3.00 a volume unbound; $3.50, bound (except Vol. 8: $1.00, unbound; $1.50 bound).

Books

Memorial Volume of the Transcontinental Excursion of 1912 of the American Geographical Society of New York. Edited by W. L. G. Joerg. Twenty-four papers, mostly on the geography of the United States, in English, French, German, and Italian, with an introduction and a history of the excursion. With numerous illustrations, including nearly forty portraits of European geographers. xi and 607 pp. $5.00 net.

The Andes of Southern Peru: Geographical Reconnaissance Along the Seventy-Third Meridian. By Isaiah Bowman. With detailed topographic maps in colors, many black-and-white drawings, and about one hundred illustrations from photographs. xi and 336 pp. 1916. $3.00 net.

The Frontiers of Language and Nationality in Europe. By Leon Dominian. With eight maps in color and twelve in black-and-white, and numerous photographs. xviii and 375 pp. 1917. $3.00 net. Out of stock.

Bering's Voyages: An Account of the Efforts of the Russians to Determine the Relation of Asia to America. By F. A. Golder. Vol. 1: **The Official Reports and Log Books of the First and Second Expeditions, 1725–1730 and 1733–1741.** With a chart of the second voyage by Captain E. P. Bertholf. Vol. 2: **G. W. Steller's Journal of His Sea Voyage from Kamchatka to America on the Second Expedition.** Translated and edited by F. A. Golder and Leonhard Stejneger. *Research Series Nos. 1 and 2.* In press.

The Battlefields of the World War: A Study in Military Geography. By Douglas Wilson Johnson. With sixty maps and block diagrams and over one hundred photographs; and separate case of plates comprising five detailed maps of the battlefields of the western front (1:300,000), three block diagrams, and six panoramas. xxvi and 648 pp. *Research Series No. 3,* 1921. $7.00.

THE GEOGRAPHICAL REVIEW

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SOME RECENT ARABIAN EXPLORATIONS

By D. G. HOGARTH, C.M.G.
Oxford University

Up to the outbreak of the war the Arabian Peninsula contained the largest unexplored and unmapped area in the world, outside Polar regions; today, seeing that its southern desert, the "Abode of Emptiness," has not yet been entered, it still retains its bad eminence; but by a smaller margin. For the war opened ways into it which had been closed since the institution of Islam and not only promoted such abatement of its jealous exclusiveness, that its natives were willing, indeed anxious, to furnish reliable information about its internal geography and ethnology, but also brought about European penetration of great districts of which not more than the bare existence had been known to us before. These districts lie chiefly in two provinces, Hejaz and southern Nejd. The last had been visited previously by no representative of western civilization; the first, except for a few points on the coast, only by disguised pilgrims. It remained virtually as dark and hidden a land as the other, since the few furtive western men who penetrated its forbidden interior could not diverge from the beaten pilgrim tracks or show a curiosity inconsistent with their assumed character.

Both these provinces have now yielded their secrets to British officers: the Hejaz to a comparatively numerous group, of which T. E. Lawrence was the pioneer and throughout the boldest spirit; southern Nejd to a single officer, H. St. J. B. Philby, who was the first European for a century to cross the peninsula from sea to sea. It must be explained how these officers came to go where they did, and to reap a scientific harvest in such fields.

The Hejaz

To take Hejaz first. All the world knows that Husein, Emir of Mecca, suddenly threw off his Ottoman allegiance in June, 1916, and hoisted his flag for independence and alliance with Great Britain. All the world does not know that he took this action not only on his own initiative, but upon

a distinct understanding that he should play his hand alone, Great Britain to help only with such sinews of war as could be got to him in time and as he was capable of using; but not with officers or men. There had been negotiations with him nearly two years earlier with a view to his giving moral support to a rising of the northern Arab-speaking peoples against the Ottoman caliph; but the military operation—a British landing in northernmost Syria—which alone could make that rising feasible was emphatically disapproved by France. The plan was abandoned; Syria was left to be dealt with so drastically by the Turks that all hope of her revolt disappeared; and nothing further was asked or expected of the Emir of Mecca. So matters were to remain for nearly a year. Then to the surprise, and not a little to the embarrassment of Great Britain, the Emir reappeared with a proposition of his own, inspired largely by pity for the Syrian Arabs and by nationalist patriotism, but a little, too, by personal ambition and by fear lest he might soon feel the Turk's hand as heavily as Syria had been feeling it during the previous six months.

British authorities were very slow about accepting an offer which would involve sending arms and supplies, then very difficult to furnish, into a new, remote and unknown theater of war. In view also of engagements to France and her known sensitiveness about Syria Britain could not guarantee more than a small part of what the Emir asked for the Arab people. But after several months of negotiations, carried on under great difficulties between Cairo and Mecca, she did agree to help Husein to revolt on the understanding that all wider questions than those which concerned Hejaz should be left open for future consideration. She knew the Emir to be so ignorant of the exigencies of modern warfare and so little able to put any force into the field capable of meeting Turkish regulars on equal terms, that the most to be hoped was that he might sustain a guerilla in his own rough hills and deserts, which would embarrass the Turks, produce a moral effect on the Moslem world, and keep the Germans from penetrating to the Red Sea coast on the flank of British communications with Mesopotamia and India. As the early months of 1916 went on even these hopes faded. The Emir proved to be even less prepared than had been feared; and he showed himself most unwilling to fix any date for action and reluctant to be guided. From his sons, whom he had sent up to Constantinople, he was receiving unfavorable forecasts of British prospects on the western front; and it is doubtful if he ever would have taken decisive action had the Turks wisely left well enough alone. But they did not. Having scored a success against British forces near Aden, the Turks conceived, in the spring of 1916, the idea of so extending it that they might be able to conduct a campaign of guerilla and propaganda in India and East Africa from a strong base in South Arabia. To that end they sent a picked force to Medina with orders to march down through Hejaz to Yemen; and at the same time they allowed a German party of experts in wireless telegraphy to try to make its way by the coast road and join that force south of the Holy Land. Emirs of Mecca

have so often suffered deposition or death at the hands of such passing Turkish columns that two of Husein's sons, who were at Medina and saw these troops assembling, became uneasy in their minds and warned their father. He saw his danger, sent word to Yambo to have the Germans held up, and despatched an S. O. S. message to a British patrol ship to the effect that he must rise then or never. I was sent down the Red Sea to learn what this message meant and to meet his youngest son, Zeid, on a desolate coral

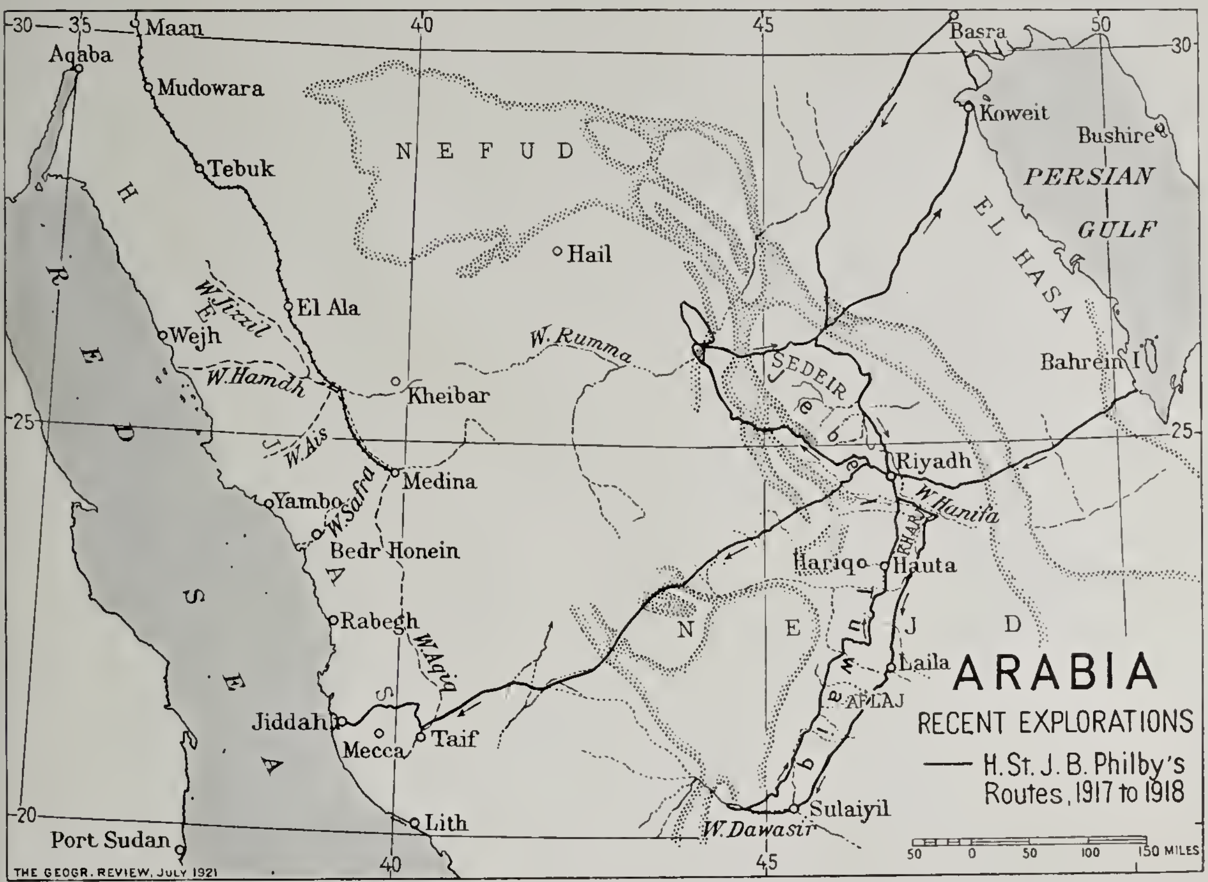

FIG. 1—Sketch map to illustrate recent explorations in Arabia after maps published by the Royal Geographical Society (see footnote 2). Arabic names on the map and in the text of this paper are as spelled by the author. On the vexed question of the transliteration of Arabic names see the note on the Permanent Committee on Geographical Names in the record section of this number of the *Review*.

beach south of Jiddah; but it was too late to interfere. The elder brothers had already invested Medina, and the rising was to begin at Mecca, Jiddah, and Taif on the fourth evening. It duly began—on June 9. British ships and seaplanes helped at Jiddah, and two batteries of Moslem Sudanese were rushed across and sent up to Mecca. That was all that could be done, beyond pushing in money, stores, and old Japanese rifles—the last more dangerous to friends than foes! Neither a British officer nor a British soldier went a mile inland. The Emir played his hand alone.

He found it easier to play after his own desultory fashion than we had feared he might. The Turkish garrisons in southern Hejaz were cut off from help by 300 miles of hostile country; they were ill-found and of very poor spirit. In three months they had all collapsed, except at Medina. In that town the Turks, with the support of the Hejaz railway, had so much

the best of it that the Emir's sons and forces were driven right away and fell back on the coast, Feisal on Yambo, and Ali on Rabegh. The Turks followed up, threatening to move on Mecca. We still believed ourselves

Fig. 2—Jiddah on the arid Red Sea coast owes its prosperity to its function as the port of Mecca.

debarred from participation in operations in this holy land and had no one ashore except a few men to supervise the landing and distribution of supplies at Rabegh; and even these mostly slept on shipboard. As autumn began, it became evident that the Emir had shot his bolt, so far as his own resources went, and was come to a full stop. His revolt had not done our cause much positive good so far, and if it led to ultimate disaster grave injury would be

wrought to British prestige in the world of Islam; for it had begun under British auspices. But what could we do in a forbidden land? We had strength to contribute; but how bring it into play?

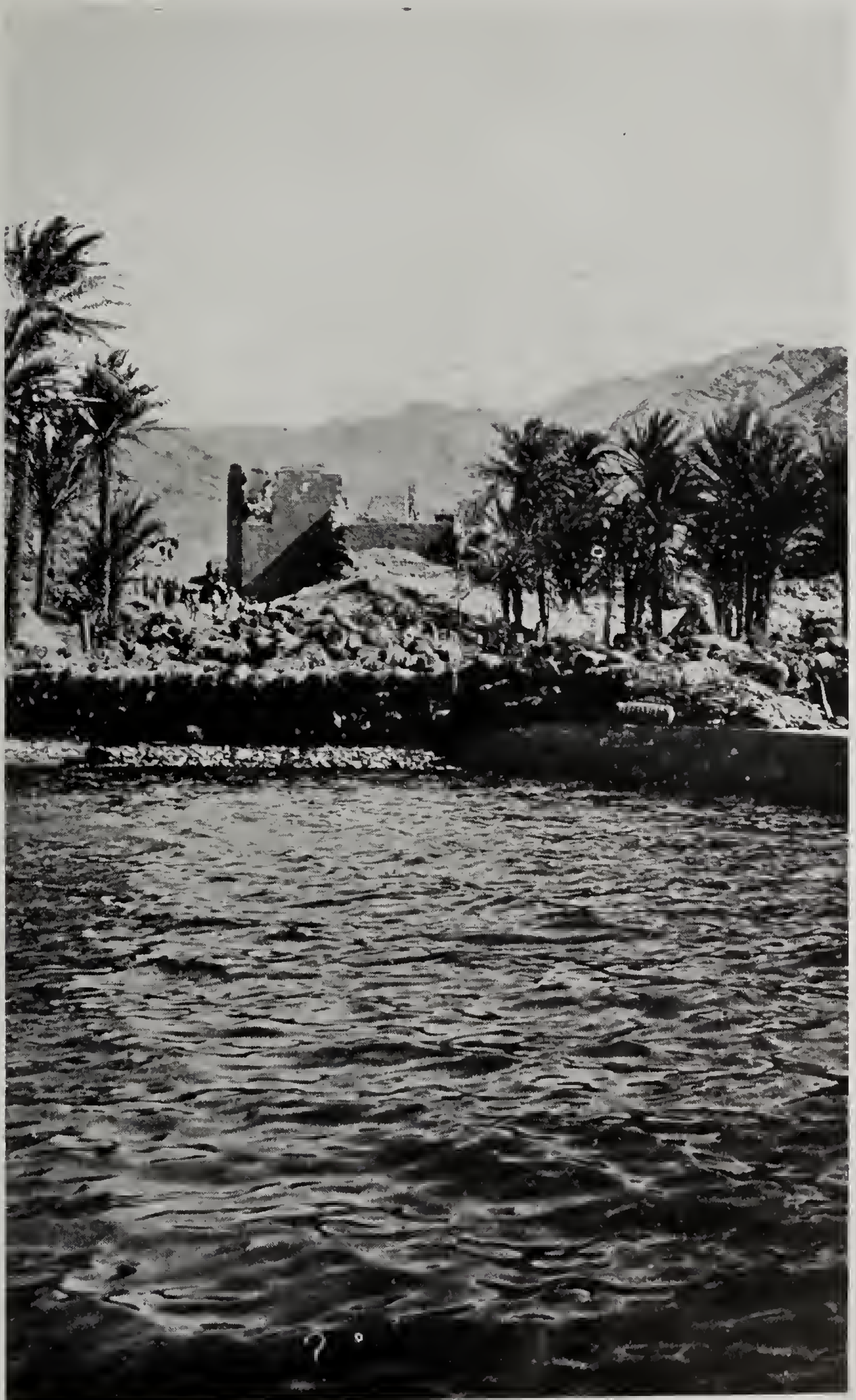

FIG. 3—The fort of Aqaba (Akaba). Aqaba at the head of the gulf of that name was a flourishing port from the days of Solomon to those of Saladin, whence dates its decline. Aqaba figured as an important station during the War.

Lawrence and Feisal in Northern Hejaz

At this juncture, in early October, 1916, a lieutenant on the staff, Thomas Edward Lawrence, was sitting in the Military Intelligence Office in Paris. He had had intimate acquaintance with Arabs before the War and had been pulling the strings of the Hejaz affair since its start. Endowed with a

compelling personality, as persuasive as forceful, a very clear head, and extraordinary initiative and promptitude, he thought more rapidly and saw farther ahead than most men. He had always believed that the Arab revolt could be led on to affect greater issues than those of Hejaz, and he felt keenly the danger of its actual crisis. Some single leader must be found for its forces and some liaison with British strength established. He asked leave to take a short holiday trip down the Red Sea on a patrol ship and turned up at Jiddah. There he met Abdullah, the second son of the Emir, and the best known to us of the family. In five minutes he knew this man was not the leader required: but he had heard better things of Feisal who was far away inland from Yambo. Abdullah was asked to call up his father on the telephone (Husein's number is Mecca 1) and get leave for Lawrence to ride inland from Rabegh. The old man demurred to this request but finally gave way and wrote a letter to his eldest son, Ali, who was in command at Rabegh. When this letter came to hand Lawrence went aboard his ship again and dropped down the coast. Ali demurred even more than his father; but Lawrence insisted on his letter and offered to don Arab clothes the better to avoid notice on the way, and to travel by night. Ali agreed at last and Lawrence slipped out of camp one evening with half a dozen Bedouins.

Three days later Lawrence walked into Feisal's tent in Wadi Safra and sat himself down. Feisal was surprised, displeased, and doubtful what his wild Bedouins might think and do; but he put the best face on the accomplished fact and asked Lawrence politely what he thought of Wadi Safra. "Very pleasant and pretty," said his guest, "but a long way from Damascus." There was a moment of acute tension; for Feisal understood perfectly that his failure before Medina and his present inaction were in his visitor's mind. But the tension passed, and he did the right thing. He set forth frankly his situation—his lack of guns and food, the impossibility of his getting up supplies from distant Rabegh, and the incapacity of his troops to prosecute siege operations and railway demolition. Lawrence saw before him the desired leader, and Feisal, as he talked for hours that day and the next, realized that he had found a man who could and would help him. He showed his visitor everything, initiated him into guerilla fighting on the flank of the advancing Turks, and sent him away in peace to sail for Cairo and persuade the British military authorities to organize a new base at Yambo for the supply of a big Arab force, which Feisal undertook to call out at once. The plan was to go north and there cut the railway communications of Medina. All this was done. Lawrence went and came again; and the result was Feisal's march with Lawrence and some 20,000 riders up the coast to Wejh in January, 1917.

From this new base among weak and, on the whole, friendly tribesmen—a base so far north, too, that it fell outside the holiest and most jealously guarded region—we were able to push inland cars, airplanes, and selected officer-instructors. Abdullah had come round Medina with another force

Fig. 4

Fig. 5

Fig. 4—The oasis of Nakhl Mubarak in the Wadi Yambo looking southwest. Emir Feisal's tents in the foreground.

Fig. 5—Abdullah's tents in Abu Markha, Wadi Ais, 1917.

and formed a camp in Wadi Ais, within a day's march of the railway. Not only Lawrence but many other British officers now donned Arab dress, as Feisal's men, and passed up and down, the Bedouins growing accustomed to the sight of them and frankly accepting their instruction and leading. The railway was attacked at many points, and the whole block of northern Hejaz from the coast line between Rabegh and Wejh up to a section of the railway nearly 200 miles long, between Abu Naim and El Ala, became familiar to Christian officers, both British and French. Lawrence was always their inspirer and moving spirit, and his way with the Arabs became our recognized canon of conduct among them.

The Geography of Northern Hejaz

What was learned about the geography of Hejaz by these officers, by the flight of our planes, by the passage of our cars, and by conversations with Feisal, with his officers, and with all sorts and conditions of his rank and file—amounts in sum to this.[1]

Hejaz is one facet of the irregular pyramidal mass of peninsular Arabia, whose apex lies some distance south of Taif. From this culminating point four gable ridges run, one south of west through Asir to the Red Sea about Hali Point, one southwards towards Aden, one northeastwards through Nejd by Sedeir towards Koweit, and one northwards by Kheibar towards Moab. Hejaz is the northwestern facet of this pyramid, enclosed between the first-named and the last of the gable ridges. A short slope falls to the west and a long one to the northwest. The short slope is marked off from the other, which declines towards Medina and Midian, by a great triangular mass of lava-covered highland (*harra*), broadening inland from a point near the sea at Rabegh to a long base between Taif and Medina. This divides Hejaz into two main districts, southern and northern, whose only ways of intercommunication lie either round the point of the *harra* near Rabegh or right round the back of it. The central *harra* itself seems to be virtually uninhabited and almost inaccessible, being not only of most forbidding surface but also without water. Lawrence has told me that he never met a Hejazi, from Feisal downwards, who could tell him anything about it. No one goes there. Our airplanes flew a little way over its mass from Rabegh, but not far. The two great pilgrim roads turn its flanks, the Darb es-Sultani skirting its northwestern face from Medina to Rabegh and then striking inland to Mecca under its southwestern face; the Darb es-Sharqi bending eastwards towards the central steppe, behind the base of the triangle and following up a long watercourse, the Wadi Aqiq, which flows from an elevation of some 6,500 feet at the apex of the peninsular pyramid south of Taif and descends the long northwestward slope to Medina where it joins a main channel called Hamdh. This rises at Kheibar and flows out to the Red Sea near Wejh. We learned for the first time about this great drainage

[1] See also the author's article "War and Discovery in Arabia," *Geogr. Journ.*, Vol. 55, 1920, pp. 422–436.

FIG. 6

FIG. 7

FIG. 6—Typical *harra* in northern Hejaz. This forbidding lava surface presents a serious obstacle to travel.
FIG. 7—Patchy *harra* in northern Hejaz with accumulated detritus which permits the growth of vegetation.

Fig. 8—Bab-el-Omrah, the western gate of Mecca. The pillars mark the limits of the sacred territory.

system from Feisal himself. The total length of its main channel, from beyond Taif to near Wejh, is not much short of a thousand miles; and it has many large feeders in its lower course, e. g. Wadi Ais from the left, which drains the southern part of northern Hejaz, and Wadi Jizzil on the right, which drains the northern part and most of Midian.

Southern Hejaz

Southern Hejaz is a comparatively low-lying tract shut in south and east by the converging gable ridges of the pyramid, and north by the southward face of the central *harra*. It is traversed by short wadis of which the chief is Fatima. This, combining drainage from the pyramidal apex northwest of Taif and from the southwestward face of the central *harra*, makes a strip of fertility a few miles distant to the north and northwest from Mecca before its ground waters sink into the dusty limestones of the low ground behind Jiddah. Shut in and low-lying as it is, southern Hejaz is a torrid, dusty tract with little grazing and therefore is not a Bedouin country. It is inhabited by many small, weak, and very old-established tribes who live on lean cultivation and on what they can make out of pilgrims. It has an economic asset in the city of Mecca, which lies at the back of it just at the foot of the abrupt eastern ascent; and another in the port of Jiddah, which is the main gate of pilgrim access. Easily dominated from Mecca, southern Hejaz is the compact home kingdom of the lord of that city and constitutes a natural holding of the Grand Shereef, extending triangle-wise from Rabegh towards Qunfudah and Hali Point.

The Oasis of Taif

Right above it, towards the peninsular apex, lies Taif, fertilized by the early waters of Wadi Aqiq before, on their way to Medina, they sink too deeply into the porous limestones. Cool and green, its valley commands the pass over the apex towards the southwestern facet of the pyramid, Yemen. Taif has therefore always exercized an important influence on the life of the Hejaz in general and of Mecca in particular; for Mecca, unless it hold this place, has at once no near refuge from the summer heats, no source of green supplies, and no passage towards the food area of Happy Arabia in the south. The Prophet treated it with particular consideration, and the Emirs of Mecca and the Turks have always been studious to keep a tight hold upon it.

Physiography of Northern Hejaz

Northern Hejaz, lying beyond the central *harra*, is reached either by way of Wadi Aqiq and Medina, or by the pass of Rabegh on the sea front. In the south it is a region of high granitic masses, divided by short, steep valleys such as Wadis Safra and Yambo, which make a little fertility in their middle courses. The chief road from Medina comes down the first of these wadis, and the point at which it debouches from the granitic hills has ever been a

scene of Hejaz warfare. There or thereabouts the Prophet, fighting from his refuge at Medina for possession of Mecca and southern Hejaz, won his two greatest victories, near Bedr-Honein.

North of this region the granitic chain runs up the coast in a series of sharp peaks to join the fantastic mountains of the Midian seaboard; and behind it the general denuded slope ascends in long limestone downs towards the main gable ridge, which runs due northward. Before this is reached, however, great masses of sandstone emerge, often covered with lava caps, and form a false ridge, which is not the water parting. In the long trough east of these *harras*, but west of the real gable ridge, runs the Hejaz railway. The long continuous upland slope is true Bedouin country, though its grazing is not rich, since it is too far north to get monsoon rains, and too far south to profit much by Mediterranean precipitation. It lies, in fact, in the same rainless belt as upper Egypt. It is seamed with countless deep wadis, almost all converging into that great drainage system which, beginning away beyond Taif, is continued from Kheibar and Medina by the Wadi Hamdh, the most important channel of western Arabia. Its ground waters make the fertile oasis and the prosperity of Medina. Then, after flowing still farther to northward and receiving the confluence of several drains from south (Wadi Ais) and north (Wadi Jizzil), the main channel turns west towards the Red Sea and burrows deep into the slope, becoming

Fig. 9—Mecca. Mahmal (holy camel) circumambulating the Great Mosque. Shereef Ali (eldest son of the Emir) in front with white turban and brown robe.

salt and unfertilizing. At one point or another this capital member of the hydrographic system of western Arabia has now all been seen and described, from its estuary just south of Wejh to within about thirty miles of Medina; and its wide ramifications can no longer hide any important secret. We now know northern Hejaz up to the central Hisma plateau of Midian and have learned much about that plateau also by subsequent penetration from Aqaba to the railway between Maan and Tebuk. The railway itself,

FIG. 10—The Great Mosque of Medina: The main dome and the subsidiary domes over the colonnades.

too, has been described to within a few miles of Medina, and its longitudinal position has been determined, in the northern part, from Maan to Mudowara. An eastward error of some miles, as shown on all published maps, was here corrected. Steps are being taken to get more of the railway line determined south of Mudowara. It appears likely that we shall find an eastward error throughout, and that Medina itself is placed too far inland by some miles. There is reason also to suspect that the eastern pilgrim road (Darb es-Sharqi), which runs thence southward towards Mecca and Taif, is charted too far to the east.

Such is Hejaz—a broken, divided, lean land, isolated from the center of the peninsula by a ring of deserts, steppes, and lavas; from the sea by a triple barrier of coral reefs. It is difficult to enter, difficult to hold, and unable to support itself by resources of its own, much less to supply the crowd of pilgrims who annually resort to it; and therefore it is fated to depend on some external society, whether Egyptian, Syrian, or Mesopotamian.

Nejd

Our Knowledge of the Region

Nejd, the inner region of the peninsula south of Wadi Rumma, had come to be well known to us in certain northern parts by the successive journeys of Palgrave, Raunkiaer, Leachman, and Shakespear, the last named having gone across it just before the War. He went up again to Riadh when war broke out, but only to meet death by rashly exposing himself in a fresh phase of that time-honored struggle between rival Emirs which has distracted central Arabia ever since the first half of the last century. The southern part, however, below and to the west of the capital, Riadh, remained wholly unvisited till Mr. Philby made his two remarkable journeys in 1917 and 1918, the one due westward right across the peninsula to Taif and Jiddah, the other southward to Wadi Dawasir and the limits of the Great South Desert.[2]

Philby's Mission in Southern Nejd

The lord of all this vast region, Abdul Aziz, the reigning member of the House of Saud, which grew great in the latter part of the eighteenth century through support of the Wahabite faith, had long feared and resisted the efforts of the Turks to extend their dominion into the center of Arabia. He broke with them in 1913 and turned their garrisons out of the Gulf province of El Hasa, thus obtaining an outlet to that sea and coming into direct touch with British naval power and the Government of India. In the Great War, therefore, his interest lay in espousing the British cause; and at the end of 1915 he concluded a definite treaty with Great Britain. What was asked of him in the War was that he should prevent his rival, Ibn Rashid, the Emir of northern Nejd, from endangering British communications on the Euphrates and supporting the Turks in Hejaz; and to this end Britain supplied him with money and arms. But he made a very poor show with them and proved so unwilling to sink an old feud with Husein of Hejaz that, in 1917, it was determined to send a mission from Mesopotamia to keep an eye on his actions and to persuade him to a more profitable and vigorous line of policy. To head this mission Mr. H. St. J. B. Philby, a civilian officer of the Political Department of India, then attached to the Mesopotamian Service, was chosen. He is an adept in vernacular Arabic, and a man of exceptional courage and endurance.

Philby was well received in Riadh but found little to do there; nor could he arrange matters between Ibn Saud and Husein of Mecca without the presence of some representative of the latter. Certain difficulties prevented the despatch of such a representative, and at last Philby determined to go himself to Hejaz and see if he could bring one back. Ibn Saud gave him

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[2] H. St. J. B. Philby: Southern Najd, *Geogr. Journ.*, Vol. 55, 1920, pp. 161–191 (noted in the *Geogr. Rev.*, Vol. 10, 1920, pp. 347–348); Across Arabia: From the Persian Gulf to the Red Sea, *Geogr. Journ.*, Vol. 56, 1920, pp. 446–468.

26 tribesmen finely mounted, and with these Philby pushed off in November, 1917, to make the first crossing of the peninsula since that made by Captain Sadlier from the Gulf to Medina and Yambo in 1818. He met with both fanatics and fighting tribesmen on his way but won through in remarkably fast time to Taif. Avoiding, of course, Mecca itself he came to Jiddah to meet Husein, and I was sent from Cairo to meet the two in January, 1918. Our long interviews and negotiations, however, led to little result and Philby, not allowed by the old king to return through Hejaz, had to get back to Riadh by making the long circuit by sea. When he returned to Ibn Saud, in the summer of 1918, he found less than ever to do, and he bethought himself of employing his time and experience in penetrating the unknown land of the south towards the Great Desert. Ibn Saud, glad to remove him from his capital, where fanatics growled at a Christian's presence, gave him a strong and trusty escort to fend off the still more exclusive fanatics of the south, where no Christian had ever been seen. Philby met some moments of peril, but he accomplished his purpose; and in a journey of some 300 miles out and 300 home he has solved for us pretty well all the riddles of southern Nejd.

Character of the Heart of Arabia

Thanks to these two journeys we now know that the heart of the great peninsula—an area of, say 75,000 square miles—is not, as had been supposed, one long decline eastwards from a crest running north and south up the western coast, but is divided diagonally into two slopes, one falling towards north-northeast, the other towards south-southeast, and that its main gable ridge runs in a curvilinear direction from a point in the north of Yemen to northern Nejd, about Sedeir. The middle part of this ridge passes through a highland country of igneous formation, whose general level is between 4,000 and 5,000 feet. It has sharp granitic peaks on the divide itself, rising to 6,000 feet and more. The existence of these highlands was previously unknown. There seem to be one subsidiary swell north of the main divide and two to the south of it—making four ridges in all to be crossed by the pilgrim road from Riadh to Mecca.

In the heart of this region lies a district, hitherto unexplored, which is capable of maintaining sparsely settled life. Water, albeit brackish, is apparently procurable everywhere in not very deep wells on the southern side of the divide. Nowhere in its area is there any extensive sandy desert, though the whole is steppe. But it is fenced off on the northwest and the southeast by sand belts, in neither case very broad or taking more than a few hours to cross. It is therefore all good Bedouin country. Philby reports talk of minerals, even gold, in it; and there is the same talk in Hejaz. In any case it is an easily traversable country; and in the light of our new knowledge we can understand both the ease with which the Prophet's arms spread across Nejd into Hasa and Oman in the seventh century and

the equal ease with which Wahabite arms spread to Hejaz and Asir in the nineteenth. We can understand also why Ibn Saud can and does claim territorial solidarity right across to the Hejaz border and how he is able to make that claim good.

Myths Dispelled

Since Philby could see, from the line of his second journey, some of the peaks of these same highlands, we can be sure that in so uniform a land as is this part of central Arabia no important secret lies hid any longer. There are to be reckoned with only the steppe sloping to southeast, the fringing desert, and the features of the oasis land of southern Nejd, down the length of which Philby's second route lay. His Dawasir trip has dispelled myths. The supposed vast habitable region south of Wadi Hanifa has shrunk, together with that great and continuous volume of trade, crossing the peninsula diagonally from Nejran, which so long was credited despite the little show it made at any point of the Gulf shore. In reality all that is capable of maintaining settled life south of Hanifa is a thin strip of alternating oasis and desert, about three hundred miles long in all. What advantages it possesses it owes to a great accumulation of sand on its southeastern edge, which blocks the farther eastward flow of drainage from the central highlands and from the face of Jebel Tuwaiq. This is dammed back as ground water under the districts of Kharj and Aflaj at so high a level that it can be collected into reservoirs by the Persian *khanat* method (*falj*). Even permanent ponds form on the surface. Philby saw at least three groups of these, some of great depth and one having the dimensions of a small mere. A rumor of this last reached French officers of Mehemet Ali's force in Asir nearly a century ago. The southeastward facet of the peninsular pyramid receives much more abundant precipitation than that which slopes to northeastward. Philby's information and observation indicate that its wadis run not infrequently in heavy flood—a fact which explains why Nejdean history shows such ups and downs of civilization and why the House of Saud, with tardy prudence, definitely abandoned valley ground for steppe in choosing the site of its actual capital, Riadh.

The Kharj District

The only desirable part of southern Nejd is a broad isosceles triangle at the northern end of the strip. Here lay the old Yamama. This region, Kharj, has running surface waters capable of fertilizing far more soil than they actually do, and extensive traces of an earlier, more enlightened and more populous society. Exposure to the central government in Riadh seems to have reduced the population of its eastern part; but in the western part the long foothill valley of Hariq, in Jebel Tuwaiq, has been able to protect itself and preserves a large urban settlement, Hauta, and two lesser towns. Hauta, however, is in no sense metropolitan but is just a self-contained, self-feeding oasis settlement, isolated in virtual independence.

The Aflaj District

South of Kharj the strip is continued by the long and narrow depression of Aflaj, of whose few oases Laila occupies the most extensive. Like Kharj, this district seems to be cut off by Tuwaiq from the pastoral life of the center and to be roamed by but few Bedouins. With increasing deterioration this strip is continued and completed by Sulaiyil, beyond which lie the great sands of the Ruba el-Khali. Philby found that a certain amount of caravan trade passed through this latter district to and from Nejran and Yemen; but the trade is on too petty a scale to redeem the settlements of Sulaiyil from their mean status of poverty-stricken hamlets. This is the leanest part of the strip.

Wadi Dawasir

Wadi Dawasir is not part of the continuous strip but lies on the contrary side of Jebel Tuwaiq and on a different drainage channel. This comes right across from the highlands of Asir, being a continuation of Wadi Ranya; and, instead of sending its waters with those of the strip, to the Sabaha depression and the Gulf of Qatar, it empties them directly into the Ruba el-Khali. The establishment of the distinction of these two important hydrographic systems of southern Nejd is the best result of Philby's expedition. He has shown further that Dawasir does not lie on any direct line between Riadh and Yemen and that it is neither so populous nor so primitive as has been supposed. While itself occupied by fairly well organized settlements, it is intimately connected with the pastoral steppes to north of it, includes a large Bedouin element of population, and has a still larger one dependent upon it.

THE REGIONAL GEOGRAPHY OF TURKEY: A REVIEW OF BANSE'S WORK *

By Ellen Churchill Semple

[With separate map, Pl. VI, facing page 350]

Turkey lies at the junction of three continents. It is thrust in between the Mediterranean and the Persian Gulf, between the Black Sea and the Red. It bridges the space between the Balkan Peninsula and Persia, between Persia and Egypt. It is a great isthmian region, dominating the chief intercontinental trade routes of the eastern hemisphere. It flanks for a thousand miles the steamer highway of the Suez Canal and Red Sea. It controls the Dardanelles and the Bosporus leading to the Black Sea lands. It is crossed by old caravan tracks and the future railroad routes connecting the Mediterranean and Black Sea ports with the Persian Gulf coast. It therefore holds a highly strategic position.

By reason of its location, Turkey has drawn the elements of its population from the grasslands of Semitic Arabia, from the highlands of Aryan Persia, from the Caspian plains of Mongolian Asia, from the multifarious race stocks of the Russian Caucasus, from the Greek coasts of the Balkan Peninsula and Aegean Isles. These it has assimilated more or less to the indigenous Hittite or Alarodian race. The peoples comprised within the borders of Turkey differ in racial and geographic origin, in language and religion, in social and economic development. On the other hand they are united by certain common bonds found in the semiarid climate of Turkey, the prevailing steppe vegetation with its concomitant, pastoral-nomadic life, the patchy distribution of the arable land, the sparsity of the population, and finally the deep underlying community of ideals molded by this environment through a process of social development unfolded from within through the ages. To these may be added the religion of Islam and the fanatical devotion of its adherents, who here number five-sixths of the people.

Anatolia, or Asia Minor

The Anatolian Peninsula stretches like a bridge between southwestern Asia and southeastern Europe. It consists of a high plateau, increasing in altitude towards the east, and rimmed on its three seaward sides by young mountains rising boldly from the coast. Structurally and racially it is part of Asia. Its wide steppe interior has been a passway for Asiatic migrations,

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* Ewald Banse: Die Türkei: Eine Moderne Geographie. 3rd edit. 454 pp.; map, ills., bibliogr., index. Georg Westermann, Brunswick, 1919. 10 x 6½ inches.

The spelling of place names in this article is for the most part in accord with the Royal Geographical Society's system. On the general question see the note on the Permanent Committee on Geographical Names in the record section of this number of the *Review*.—Edit. Note.

but the massive mountain barriers which trace the northern and southern coasts have excluded oversea immigrants from Europe and thus maintained the Asiatic solidarity of the peninsula. Only the Aegean front, with its deeply embayed coast and its structural valleys opening westward, has been hospitable to Hellenic colonization and European influences.

The rain-bearing winds from the neighboring seas expend their moisture on the outer slopes of the coast ranges (rainfall 600 to 1,000 mm.) and reach the interior impoverished. Hence the plateau core has an arid climate, extensive steppes or saline wastes where nomads pasture their herds, mountains bare or thinly covered by a scrubby growth of trees on the high inland slopes, and shallow U-shaped valleys drained by meager streams which serve to irrigate strips of tillage land along the interior piedmont. The coast ranges get ample precipitation for winter grain crops along their lower slopes, where the typical Mediterranean vegetation prevails, and they have abundant water to irrigate in summer the orchards and gardens of the deltaic plains or valley lowlands at their base. On their upper slopes they support a magnificent belt of forests, which averages 60 miles in breadth and comprises one-third of Anatolia's area.

The Marmara Coast Lands

The Marmara region comprises the indented coast lands encircling the Sea of Marmara and the Straits—namely, eastern Thrace, the Troad, Lesser Phrygia, and Bithynia. It belongs both to the Mediterranean and Pontic climatic provinces and combines the vegetation appropriate to each. Thrace is a Quaternary plain, screened on the north by low mountains which partly fend off the moist winds from the Black Sea and give Thrace a steppe vegetation more suggestive of Asia than of Europe. Cultivated fields and orchards are distributed along its valley floors, especially in the moist lowland of the Maritsa River. The Asiatic half of the Marmara region, owing to the disposition of the mountain ranges in successive tiers well back from the Pontic shore, is accessible to the Black Sea winds and gets ample rain (800 mm.) over most of its area. Agricultural products in great variety—grains, olive oil, wines, linseed, flax, cotton, opium, sesame, and mulberry trees for sericulture—are raised along the seaward slopes, while the valleys in the rain shadow are either cultivated by irrigation or afford pasturage for cattle. Oak and fir forests on the high ranges attest the influence of the Pontic winds.

Constantinople, intercontinental capital, holds the head of the Anatolian bridge and controls the marine highway of the Bosporus.

Northern Anatolia

Pontic Anatolia comprises the northern mountain zone of the peninsula. Its relief consists of steep-sided horsts, dissected into mountain chains, which rise directly from the coast and increase in elevation from west to

east. The rugged littoral has few ports and difficult hinterland connections. The region is distinguished by its Pontic climate, characterized by ample precipitation all year round on the seaward slopes, though west of Samsun the rainfall shows a marked summer minimum. Eastward precipitation increases from 727 millimeters at Samsun to 875 millimeters at Trebizond and 2,500 millimeters at Batum. Behind the mountains it declines rapidly to 400 millimeters on the margin of the interior plateau. Dense forests of conifers and deciduous trees on the rainy seaward slopes support a big lumber industry. Sawmills on the perennial torrents convert the logs into planks, which are exported through Samsun, Sinope, and Trebizond to Mediterranean markets. The subregion of Paphlagonia and the adjacent district of Djanik in eastern Pontus are distinguished by longitudinal valleys near the coast, which contain long bands of settlements and farms, and carry the only roads parallel to the littoral in all this region. Djanik has the only fairly good ports (including Samsun) and the only fertile deltaic plains. Lazistan, a narrow zone of lofty forested mountains stamped with isolation, is crossed by the caravan route from Persia and Armenia to Trebizond, *entrepôt* for a large plateau hinterland.

The Plateau Interior

The central region is characterized above all by its dry plateau character. The rain falls chiefly in spring, when it provides temporary pasturage for the Turcoman and Kurdish nomads. The zone of settlements, dependent upon irrigation streams, is fairly broad in northern Cappadocia and Galatia, where the old folded ranges derive some rain (350 mm.) from the Pontic winds; but it is narrow in the south, where the Taurus rampart excludes the Levantine winds. The desert core of the plateau nearly coincides with the province of Lycaonia, which gets only 200 millimeters of rain annually. In the Konia plain, however, German enterprise in 1912 reclaimed 100,000 acres of land by irrigation works which tapped the Isaurian lakes in the Taurus Mountains. In eastern Cappadocia the great volcanic mass of Mt. Erdjias (13,317 feet) forms a climatic island with a local precipitation of 800 millimeters, chiefly in the form of snow which lingers on the summit late in summer. Its streams irrigate a belt of fields and gardens planted in the tufaceous soil about its base and maintain numerous villages and towns, chief of which is Kaisariya. Phrygia, the western province, is a highland of good pastures and arable valleys because it is fairly accessible to the Aegean winds which here penetrate through gaps into the interior and bring 400 to 500 millimeters of rain.

Western Anatolia

This region embraces the Aegean front of Asia Minor. Its highly articulated coast and its valleys of subsidence extending from the Aegean embayments into the interior have made it hospitable equally to the moist sea

winds and to oversea peoples. The relief is extremely varied. Old folded mountains in the north and south and the Lydian crystalline mass in the middle have all been modified by elevations and subsidences, overlaid in the north and middle by Tertiary deposits and volcanic outflows, and subjected to various degrees of erosion according to the rainfall. The climate is typically Mediterranean, with a summer drought lasting three months in the north and six months in the south. The rainfall, which is 653 millimeters at Smyrna, declines gradually from the coast inland; it is 500 millimeters sixty miles from the sea.

Mysia, exposed to the Pontic rains, has a very dissected relief, which has proved an obstacle to communication and cultural development. The rains nourish large forests of pine, oak, and beech, extending from the coast far into the interior. The late Tertiary deposits provide in general fertile soils; but, owing to difficult communication, the agricultural districts are small and scattered, except in the plain of Pergamum, where the Caicus valley opens a highway from the coast. There the alluvium produces various crops, while the bordering slopes are planted in orchards and vineyards. Lydia, with its ample Tertiary deposits, fertile volcanic soils, and adequate rains, is the land of tillage. Its abundant harbors and long subsidence valleys make it also a land of traffic routes between coast and interior and explain the big export trade of Smyrna. Caria has an infertile soil which neutralizes the advantages of its embayed coast. Only the Meander valley forms a belt of alluvium which flanks the crystalline mountains to the south and produces grains, hemp, cotton, and tobacco. Where the alluvium meets the crystalline rim of the valley are the famous "Smyrna fig" plantations.

Southern Anatolia

This region is traversed by the folded ranges of the Taurus system which extends in a shallow crescent from the Anti-Taurus to central Phrygia. The mountains intercept the rain-bearing winds from the Levantine Sea and therefore have abundant forests on their seaward slopes; but the inner flanks support only pasturage and irrigated patches of tillage land. The climate is typically Mediterranean along the coast; the five months of summer drought is broken only by occasional cloud-bursts. In Lycia the mountains rise directly from the sea. The rugged coast is broken at intervals by little deltaic flats at the heads of protected bays, where population concentrates and cultivates plantations of subtropical fruits. Pamphylia embraces the narrow coastal plain at the head of the Gulf of Adalia. Its villages and farms are distributed along the inner piedmont border, which combines good drainage, fertile soil, and ample irrigation streams for the cultivation of cotton, sugar cane, and various southern fruit plantations. Near the sea a broad zone of swamps and lagoons repels settlement but attracts the Yuruk nomads who pasture their herds in the marsh meadows. The hinterland, Pisidia, is a densely forested mountain region cut by long,

gorgelike valleys which admit the rain-bearing winds far into the interior and open above into the high lake region of Isauria.

Cilicia

This region comprises the big subsidence plain at the head of the Gulf of Mersina, together with the vast semicircular rampart of mountains which enclose both plain and gulf. Located at the inner angle of the Levantine Sea, Cilicia forms a transit land between Anatolia and Syria. It shares in the history and culture of both countries, despite the multiple ranges which enclose it on three sides. These folded ranges, lofty and well forested on their seaward slopes, rise to plateau-like summits in the interior, where reduced rainfall and steppe vegetation restrict tillage but encourage pastoral nomadism. The northern half of the Cilician lowland has been reduced to a peneplain, only 250 feet above the sea, by the erosive action of the streams of the Anti-Taurus. The surface shows a thin sheet of humus overlying a coarse conglomerate. The climate is hot and semiarid, while the deeply incised streams are not available for irrigation. Nomad stock raising prevails here. In contrast, the southern half consists of a fertile alluvial plain built up in a shallow bay and abundantly supplied with typical deltaic streams available for irrigation. It is planted with a great variety of subtropical crops and its well drained portions are sprinkled with towns and villages. The low swampy coast is still unoccupied. The Cilician plain, which was a famous district of production in early Greek and Roman times, has recently been recolonized by Egyptian, Syrian, Cretan, Bulgarian, and Circassian peasants, who have brought 1,000 to 1,200 square miles of its fertile soil under cultivation and dislodged the old Turkish population. The northern or piedmont zone is also in large part arable, but its development must wait for railroads and colonists.

Armenia

Armenia is a high plateau (5,200 to 6,000 feet) located behind the lofty Lazistan ranges and almost barred alike from the rains and the cultural influences emanating from the Black Sea. It is bordered on the south by the Armenian Taurus, which greatly impedes communication with the Mesopotamian plains. It is crossed, east and west, by folds of the Anti-Taurus and Zagros Mountains, which have been disturbed by recent volcanic upheavals and overlaid by vast lava flows, so that the relief of the country is extremely complex. Its valleys are blocked on the east by lofty ranges, whose passes are snow-bound eight months in the year, and they open westward upon high and arid plateaus which form an inhospitable transit land to Anatolia. Armenia is a natural stronghold, giving its possessor a grip upon the surrounding countries. It has always been an object of conquest for neighboring states who wanted it for a border fortress against aggression.

The climate of Armenia is distinguished by the severe snowy winters, which, owing to the altitude, last for six to eight months. Precipitation is confined to winter and spring, except in the extreme north, where the Pontic winds bring occasional summer showers to the plain of Erzerum (6,200 feet). The annual rainfall is 800 to 600 millimeters in the high eastern portion but sinks westward with declining altitude to 500 millimeters and beyond the Euphrates drops to 350 millimeters. Armenia is pre-eminently a steppe land, because the short summer period warm enough for plant growth is arid both on the mountains and in the valleys. The forests, which are scant and few, are practically confined to the valleys, because the protracted cold and the violent winds of the mountains prevent their growth. Therefore pasture lands are widespread, nomad stock raising prevails, and tillage areas are insignificant except in a few lacustrine expansions of the longitudinal valleys.

The Interior Plateau (Inner Armenia)

This plateau region, despite its elevation, is a subsidence area in relation to the high mountains on its northern and southern borders. Offshoots of the Anti-Taurus folds defining its northern boundary rise to 8,000 or 10,000 feet; they offer, however, fairly easy passes by which the thinly strung villages of the valley of the Frat Su (northern branch of the Euphrates), especially the cities of Erzingan and Erzerum, maintain connection with the plateau towns of eastern Pontus and Russian Armenia and through these with the Black Sea ports.

South of the Frat Su runs the great divide of Armenia which separates this longitudinal valley from the Murad Su. It is a lofty folded system, overlaid in the south and east by volcanic deposits which everywhere level up the inequalities to wide plateau surfaces. Its steep northern front marks the southern limit of the Pontic winds and the northern limit of the Kurds. Its long southern slope is semiarid, covered with sparse summer pastures and affording small lacustrine basins utilized for agriculture. It comprises Dersim, an isolated mountain country north of Kharput, which maintained its independence till 1908; the high level plateau of Bingöl Dagh, inhabited by pastoral Kurds and Armenian villagers, the latter forming one-third of the total population; the Lake Van province, cradle of the Armenian folk, who in this province alone form a majority of the population; and finally the upper Murad province, through which runs the old caravan track from Tabriz to Erzerum, traversing a lacustrine trough along the base of the Aghri Dagh frontier range.

West of the Euphrates the mountain structure of Armenia extends with diminished relief into an undulating plateau which rises westward to the Cappadocian frontier. Its steppes are grazed by the cattle, sheep, and goats of Kurdish and Turcoman nomads. Its few villages are occupied by Turks and sedentary Turcomans.

Southern Armenia

This region comprises the broad belt of folded mountains, formed by the Armenian Taurus and Zagros systems, which separate Inner Armenia from the Mesopotamian depression. This barrier, readily crossed at few points, marks the limit of Semitic expansion from the southern plains; but the peoples of the plateau interior, both Kurds and Armenians, have easily descended through the passes to the fertile Mesopotamian piedmont and there exploited its pastoral and agricultural possibilities.

The Commagene province west of the Euphrates consists of a high plateau core flanked north and south by narrow mountain folds. Its rivers flow through deeply cut transverse valleys to the Euphrates. Steppe vegetation appears after the scant spring rains. Tillage is practically confined to the valleys and base of the mountains, where the Malatia and Marash valleys are centers of dense population and varied agriculture.

The Armenian Taurus, rising steeply from the Murad Su, sends most of its drainage southward. Owing to scant rainfall the slopes are bare or dotted with clumps of dwarf oak. At the southern openings of the narrow valleys are intermittent groups of settlements with small terraced and irrigated fields. Near the lower Murad Su, just above its confluence with the Euphrates, is a productive agricultural plain which supports Kharput and Mesere. South of Lake Van the Taurus meets the yet higher and broader Zagros folds. Thin oak forests dot the slopes up to 6,000 feet. This is a wild, almost impenetrable country inhabited by independent Kurdish tribes who combine a little terrace agriculture with extensive nomadic stock raising.

Mesopotamia

Mesopotamia is a large subsidence basin, surrounded by the Armenian Taurus on the north, the Zagros on the east, and the Syro-Arabian plateau on the west. It slopes from the Tauric piedmont at 3,000 feet down to the Persian Gulf; two-thirds of its area lies below the 1,000-foot contour line. The deltaic lowland of Babylonia, extending from the sea to the inner edge of the alluvium at 300 feet elevation, presents a sharp contrast to upland Mesopotamia, which rests upon a rock foundation. Upland Mesopotamia falls into three natural regions, distinguished from each other by geological structure, relief, and rainfall.

The annual precipitation, which is confined to winter, is meager. Below the 1,000-foot contour it nowhere exceeds 250 millimeters, but it increases to 390 millimeters at Urfa at 1,600 feet and to 490 millimeters at Diarbekr in the Tauric piedmont at 2,035 feet. In the northern piedmont districts rains fall during several months and suffice for winter crops of grain, but drought destroys the harvest every four or five years. Elsewhere irrigation is imperative for all tillage.

Northern Mesopotamia

This region embraces the northern upland and piedmont; it is defined on the south by a line connecting Mosul on the Tigris with Membidj on the Euphrates, which may be taken as the boundary of the well-watered area. The region comprises several subregions. The Upper Tigris district, a Miocene plateau overlaid with basaltic lava, stretches from the foothills of the Taurus on the north to the volcanic mass of the Karadja Dagh on the southwest and the bold scarp of the limestone plateau of Tur Abdin on the south. It has a moderate rainfall (500 to 600 mm.), which is protracted into April, and abundant streams which irrigate fields of rice and cotton, besides extensive orchards, vineyards, and gardens. Agricultural villages are scattered fairly evenly over the district. Cities like Diarbekr and Sert owe their prosperity to their location on important traffic routes, rather than to local production. The Karadja Dagh massif (6,068 feet) and the Tur Abdin plateau (3,300 feet) offer little inducement to tillage, but their reservoirs of winter snow feed the abundant springs and streams which flow southward to form the Khabur River and which irrigate a belt of gardens, orchards, vineyards, and fields stretching along the alluvial piedmont plain. Farther west a limestone subregion of block mountains, 2,400 or 2,700 feet in altitude, gives rise to the Balikh River, whose troughlike valleys support a varied agriculture and a dense population.

Beyond the southward reach of these streams steppe vegetation and Arab nomads hold sway. To the southeast, however, the long, detached range of the Sindjar Mountains rises high enough (4,600 feet is the culminating height) to extract some moisture from the clouds and to support irrigated oases along its base and good pastures on its slopes. This climatic island is the asylum of the semipagan Yezidis.

The population of Northern Mesopotamia consists of Kurds, mingled with intrusive Armenians along the highland border of the region and with sedentary or nomadic Arabs along the southern margin.

Central Mesopotamia, or El Djesireh

This region lies between the northern piedmont and the Babylonian lowland and is distinguished from both of them by its pronounced steppe character and its meager area fit for tillage. Cultivation is restricted to small patches scattered along the valley floor of the Euphrates and its two tributaries, the Khabur and Balikh. The whole region is a flat, arid plain whose vegetation, green only in spring, becomes sparser and shorter-lived from north to south. Shammar Arabs pasture their herds of sheep, camels and horses over the steppe and market their wool products in the border towns of Aleppo, Baghdad, and Mosul.

Eastern Mesopotamia

Eastern Mesopotamia embraces the terraced foreland of the Zagros, crossed by spurs and seamed by snow-fed rivers from the ranges behind.

Tillage land and irrigation streams lie side by side, but their economic development is jeopardized by the raids of mountain Kurds and Arab nomads. The northern province, Assyria, gets enough rain for winter grain crops but applies irrigation to its orchards and gardens. Farms and villages are densely distributed over the triangle between the Tigris and the southern watershed of the Great Zab. This province is the focus of roads leading in all directions—a fact which explains the prosperity of ancient Nineveh and modern Mosul.

The southern foreland, extending from the Great Zab basin to the Diala, is distinguished from the northern province by its greater breadth, its warmer and far drier climate, its predominant steppe area, the necessity of irrigation for all tillage, and the equal division of the country between Kurds in the eastern part and Arabs in the western. Settlements and farms stretch in a narrow belt between two chains of foot hills. Abundant petroleum wells promise wealth in the future.

Southern Mesopotamia, or Babylonia

This region occupies the broad alluvial depression between the foothills of the southern Zagros and the escarpment of the northern Arabian plateau. The soil consists of gravel and sand overlaid with clay, marl, and mud. The level surface and the shallow beds of the rivers which offer conditions for irrigation also permit widespread inundations. About two-thirds of the whole area is under water in the flood season from March to August; an equal amount is dry from October to February.

Northern Babylonia occupies the head of the deltaic lowland. This location, relatively high, insures good town sites and fair drainage while it admits few permanent swamps. The largest tillage district lies between the Tigris and Diala and is watered by canals from the mountain stream. It raises grains, fruits, tobacco, cotton, sesame, rice, and dates. Baghdad, located at the focus of various caravan routes and at the head of steamer navigation on the Tigris, relies both on its trade and its local production. Western Babylonia, divided between swamps and tillage land, has many small villages and several towns along the arms and canals of the Euphrates. In lower Babylonia, a region of widespread swamp, steppe, and saline desert, agriculture is negligible, except in the Shatt-el-Arab district, which forms a band of palm oases along the river and produces the finest dates in the world. These are exported in vast quantities through Basra, the river seaport on the Shatt.

Northeastern and Northern Arabia

The Turkish border region of eastern Arabia forms a transition zone between the plateau interior and the Persian Gulf-Mesopotamian depression. It is an arid steppe inhabited by independent Bedouin tribes, over whom the Porte exercised a shadowy authority definitely overthrown by Ibn Saud of

the southern Nedjd in 1913. The low coast land of El Hasa is supplied with abundant ground water, which drains down from the interior and in many places is reached by shallow wells. Date culture and pearl fisheries form the chief occupation of the people. Persian influences, both ethnic and religious, have permeated the region from the opposite coast.

Syria

Syria comprises the belt of fairly well-watered highlands, located between the Mediterranean and arid Arabia. The grain of the highlands runs north and south and shows four parallel bands of relief and climate: (1) a belt of block mountains or plateaus along the coast, with moderate or ample rainfall according to altitude and location; (2) a long middle rift valley with meager rainfall; (3) an inner highland accessible on its western slope to the rain-bearing winds; (4) a semiarid plateau hinterland. These successive belts of relief and climate appear in the four maritime geographical regions of Syria, which are therefore fundamentally similar, though differentiated in various minor features. The corrugated relief would make Syria a long-drawn barrier were it not for several transverse subsidence troughs which open passways from the coast to the interior. The rainfall, though variable in amount, is everywhere confined to winter. The summer drought is long.

Northern Syria

This region is characterized by a relatively low relief wherein the feature of twin highlands and rift valley is scarcely apparent. The surface is an undulating plateau, adapted to agriculture in the north, owing to the Orontes break in the coast range which admits the rains from the Mediterranean into the interior and gives Aintab an annual precipitation of 560 millimeters. The southern portion has irrigated tillage strips along the streams flowing down from the Kurd Dagh, with grazing land in the interfluvial spaces. Low relief and ready access to the coast make this region a natural transit land between the Mediterranean and the Euphrates.

Steppe Syria

The coast range of Steppe Syria is a dissected horst, rising from the coast in natural terraces which afford excellent conditions for agriculture and sinking steeply to the rift on the east. This valley, drained by the Orontes River, spreads out into cultivated plains about Homs and Hama but narrows sharply towards the north. The eastern mountain range is here supplanted by a dissected plateau too low to cause rain. Therefore tillage is confined to the western part of the region, and the steppe hinterland is correspondingly expanded.

Central Syria

Central Syria consists of the Lebanon Mountains and their hinterland. The region is distinguished by the possession of several mediocre ports; by

the high altitude of both the eastern and western block mountains; by the considerable elevation of the rift valley, which is 3,600 feet at its highest point; and by a rainfall which is heavy on the Mediterranean slope of the Lebanon, considerable in the rift valley and on the western side of the Anti-Lebanon and Hermon, but which suddenly ceases in the rain shadow of this high eastern barrier. Hence tillage, which flourishes to the westward, stops short east of the Anti-Lebanon and Hermon, except where the drainage streams from these create the Damascus oasis in the interior. The coastal belt produces various subtropical fruits, tobacco, cotton, and mulberry trees for sericulture. The Lebanon trough raises grain, mulberry, and olive trees, while gardens, vineyards, and orchards dot the western slope of Mt. Hermon and Anti-Lebanon up to 5,200 feet.

Palestine, or Southern Syria

This region is distinguished from the preceding by the presence of a narrow coastal plain, which is totally lacking in safe harbors; by the lower elevation and plateau form of its eastern and western highlands; and especially by the depression of the rift valley below sea level. Lower elevation, combined with a southern location and proximity to the Arabian Desert, makes Palestine the driest region of Syria.

The western highlands get from 500 to 650 millimeters of rain, which suffices for various winter crops, for olives, and for vineyards. The maritime plain, with only 200 to 400 millimeters of rain, depends upon irrigation; it finds the necessary water in the abundant springs which burst forth at the base of the Judean limestone plateau and in the high ground-water table in the plains of Sharon and Philistia, which is reached by shallow wells. The Jordan valley has a meager rainfall from 400 millimeters in the north to 200 millimeters in the south. The waters of the Jordan itself flow in too deep-sunk a bed to be generally available for irrigation, but patches of land on the old Jordan Lake strands are irrigated from springs and wadis. The eastern highland, with a moderate rainfall (400–600 mm.) only in the northern or Golan district, combines limited tillage with stock raising, sedentary with nomad life, in the Ammon and Moab districts.

Hauran

Hauran is an inland plateau region located between Mt. Hermon and the elongated volcanic mass of Mt. Hauran (5,200 feet), whose streams irrigate a broad belt of fertile country at their base, converting an arid district into the granary and garden of Syria. The Damascene, or Damascus district, occupies a terrace at the eastern base of Anti-Lebanon covered with alluvial deposits and watered by canals from the Barada and Awaj Rivers. It supports eighty villages, with their orchards and gardens, several towns, and the city of Damascus—a border market of the Syrian Desert and focus of

many roads. Southward from Damascus extends the fertile lava plateau of Nukra, or Bashan, watered by ample streams and producing excellent crops of wheat and tobacco on the rich volcanic soil which covers the underlying limestone.

Western Arabia

Syria links Anatolia with the Holy Land of Islam. Western Arabia comprises a belt of territory about 140 miles wide, extending for 1,300 miles along the Red Sea coast, the terraced escarpment, and high rim of the Arabian Plateau. Its profile is everywhere the same—coral reefs and coral strand at the foot of white cliffs; then a strip of desert plain with an occasional group of palms growing at a wadi mouth; beyond this, walls of rock rising in terraces to the plateau rim, 6,000 feet high or more and loftier in the south than in the north. Despite this nearly identical relief, Western Arabia forms two distinct geographical regions, sharply differentiated by their rainfall.

The northern, or subtropical region, includes Midia, Hedjaz, and Asir. Its rainfall, which is confined to winter, is very variable and probably less than 200 millimeters a year. The region is steppe or semidesert given over to pastoral nomadism supplemented by a little irrigation tillage in the scattered oases. The Hedjaz, with its sacred cities of Mecca and Medina, imports all the food consumed by its crowds of pilgrims. Asir, the southern province, located on the margin of the tropical rain belt, has numerous and even extensive oases watered by full winter streams. It raises enough wheat, barley, grapes, and various fruits for its own needs, with a slight margin over for export.

Tropical Arabia, or Yemen, Arabia Felix of the ancients, lies in the belt of the summer monsoons and, by reason of its lofty mountains, which, south of the 14th parallel, are 10,000 feet high, receives 600 to 1,000 millimeters of rain. Precipitation decreases northward, however, and at the 18th parallel is only 250 millimeters. The rains last from May to September. Agriculture is the basis of the economic life. The steep slopes have been terraced for gardens and orchards, fields and vineyards, up to 6,000 feet. Barley, rye, almonds, figs, peaches, apricots, apples, pears, bananas, lemons, plums, and walnuts thrive nearly everywhere. The coastal plains and piedmont produce dates, sesame, cotton, and indigo. Higher up grow wheat, tobacco, and especially coffee. The climatic zones of altitude give rise to active domestic exchanges. The export trade, which is inconsiderable, goes out through Hodeida and Aden.

Behind the rain screen of the mountains in both tropical and subtropical Arabia the picture is the same: a bare plateau, watered by rare winter showers, harbors a few villages in its scattered oases, while Bedouins set up their black tents in the widespread steppe desert. The southern Nedjd with its desert stretches broken by groups of oases in the upland belt of the Tuwaik has been described in the preceding article.

CLASSIFICATION OF THE NATURAL REGIONS OF ASIATIC TURKEY (AFTER BANSE)

Asia Minor (Anatolia)
- Marmara Province
  - Thrace
  - The Troad
  - Lesser Phrygia
  - Bithynia
- Northern Anatolia
  - Paphlagonia
  - Eastern Pontus
- Inner Anatolia
  - Cappadocia
  - Lycaonia
  - Galatia
  - Phrygia
- Western Anatolia
  - Mysia
  - Lydia
- Southern Anatolia
  - Lycia
  - Pamphylia
  - Pisidia
  - Isauria
  - Cilicia: Highland Cilicia, Cilician Taurus, Lowland Cilicia, Amanus Range, Anti-Taurus

Armenia
- Inner Armenia
  - Middle Euphrates District
  - Erzerum District (transitional)
  - Upper Murad District
  - Lake Van District
  - Bingöl District
  - Dersim
  - Western District (transitional)
- Southern Armenia
  - Commagene Taurus
  - Armenian Taurus
  - Zagros Mountains

Mesopotamia
- Northern Mesopotamia
  - Upper Tigris District
  - Karadja District
  - Tur Abdin
  - Khabur Headwaters District
  - Djebel Sindjar
  - Northwestern Limestone District
- Central Mesopotamia (El Djesireh)
- Eastern Mesopotamia
  - Assyria
  - Eastern Scarp District
- Southern Mesopotamia (Babylonia)
  - Northern Babylonia
  - Western Babylonia
  - Central and Eastern Babylonia
  - Delta District

Syria
- Northern Syria
  - Aleppo Plains
  - Kurd Mountains
  - Kara Su Trough
  - Northern Gateway
- Steppe Syria
  - Hinterland
  - Eastern Border Mountains
  - Orontes Valley
  - Ansariyeh Mountains
  - Nahr-el-Kebir Gateway
- Central Syria
  - Phoenicia
  - Lebanon
  - El Bikâa
  - Anti-Lebanon
  - Hinterland
- Hauran Province
  - The Damascene
  - Eastern Basalt District
  - The Hauran
  - The Ledja
  - Nukra Plain
- Palestine (Southern Syria)
  - East Jordan Land
    - Golan
    - Gilead
    - Ammon
    - Moab
  - El Ghor
  - West Jordan Land
    - Galilee
    - Samaria
    - Judea
  - Coastal Plain

Northeastern and Northern Arabia
- El Hasa
- Northern Arabia

Western Arabia
- Subtropical
  - Wadi el Araba
  - Arabia Petraea
  - Midian
  - Hedjaz
  - Asir
- Tropical (Yemen)

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THE PHYSICAL GEOGRAPHY OF THE SOUTHERN PART OF THE MALAY PENINSULA*

By J. B. Scrivenor
Geologist, Federated Malay States

The term "Malay Peninsula" covers the portion of Asia that forms a continuation of the region where Burma and Siam meet. Unfortunately the term is not precise; the southern end of the Peninsula is clearly defined; on the other hand a difference of opinion exists as to where the Peninsula ends and the Isthmus of Kra begins, both latitude 10° N. and latitude 13° N. having been given recently as the northern limit. The land with which we are concerned in this paper is almost the same as "British Malaya" and comprises the land between latitude 1° 7′ N. and latitude 7° N. In this area there is some Siamese territory to the north-northeast; the remainder, with adjacent islands, is made up of the Straits Settlements (Penang, Province Wellesley, the Dindings, Malacca, and Singapore), the Federated Malay States (Perak, Selangor, Negri Sembilan, and Pahang), and the Protected States (Perlis, Kedah, Kelantan, Trengganu, and Johore).

Climate of the Peninsula

Situated in the warm seas of the tropics and remote enough from the volcanic arc of Sumatra and Java to be untroubled by eruptions and earthquakes, untouched also by the devastation of typhoons, the Malay Peninsula is one of the most favored corners of the world. The rainfall is heavy, varying from about 80 inches to 160 inches per annum, according to the position of the recording station with regard to the mountains, and is distributed fairly equally throughout the year. It is often claimed that seasons can be recognized; but a study of statistics convinces me that, south of Kedah at any rate, the only division of seasons is that once put forward by a wit who remarked that one might recognize a "wet" and a "wetter" season. September, October, and November are generally wetter than the rest of the year; but it does not often rain before noon in any month. There is an abundance of sunshine, and sometimes dry spells of a fortnight or so occur. In Kedah and northwards wet and dry seasons are recognizable.

The heat is not great. The average daily maximum shade temperature is 88° F., and I believe that 100° F. in the shade has never been recorded.

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* I am indebted to Mr. C. Boden Kloss, Acting Director of Museums, F. M. S., for suggestions in connection with this paper and for the loan of photographs of Gunong Tahan.

The nights are cool enough for comfortable sleep. But, while the actual thermometer readings are low compared with those in some other countries, the daily maxima and minima vary little throughout the year, and the air is laden with moisture. There is no cold season. On the low ground the thermometer occasionally drops below 70° F. at night; at an altitude of 7,160 feet I have seen it drop to 54°; but after much experience in various stations I think that a range of 70° to 88° F. throughout the year expresses the general shade temperature of the country, including the night.

On the east coast the northeast monsoon blows fairly strongly between November and March; on the west the force of the southwest monsoon is broken by Sumatra. Generally speaking, day breaks on a perfectly still atmosphere; then a light breeze springs up and may increase to a stiff breeze later. Squalls occur sometimes that do local damage.

The Soil, Vegetation, and Scenery

The warm, moist climate has attacked the surface rocks and formed soils that support a luxuriant vegetation. Before man made clearings nearly the whole country was covered with jungle dense enough to shut out a view of anything beyond a hundred yards. Big game hunters state that in virgin jungle forty yards is the usual range at which they get a shot. The abundant rainfall, however, has created a network of rivers where one can see nature at the height of tropical beauty. No artist has yet done full justice to our Malayan rivers, flanked by giant trees of varied hues of green, gray, and brown; sometimes meeting overhead to form a shady avenue along which one can drift downstream for miles; now tumbling over rapids, now flowing peacefully through Malay villages to the beautiful east coast with its sandy beaches, bright sunshine, and fringe of *Casuarinas*—beaches that contrast favorably with the muddy, crocodile-infested mangrove swamps of the west coast, where sandy beaches are not so easy to find. On some of the highest peaks of the mountain ranges the vegetation thins sufficiently to enable one to enjoy to the full, without cutting down trees, an extensive view of billowing, jungle-covered country; and on the highlands below the summit of Tahan (7,188 feet) one can walk over open spaces at about 5,000 feet where a very poor soil and the northeast monsoon have checked the growth of everything but low scrub (see Figs. 6 and 7).

In addition to fertile soils, the Peninsula has mineral wealth. Few lands have been so well endowed by nature; but on the other side of the account we find tropical diseases, the gradual sapping of energy by the constant moist heat, and numerous flying and crawling things that bite and sting. Nevertheless, many persons manage to live here, with occasional holidays in a cold climate, for the greater part of their working lives; few, if any, escape being infected with malaria; but nowadays deaths from it among white people are rare.

Biogeographical Indications of Land Movements in the Peninsula

Before describing the present configuration of the Peninsula I will sketch very briefly the opinions generally held by biologists concerning the effect of land movements in the Peninsula and Archipelago relative to sea level, as indicated by the distribution of fauna and flora.

This area was the scene of Dr. Alfred Russel Wallace's classic work, and to him we are chiefly indebted for the elucidation of the problems of distribution.

In 1896 Mr. R. Lydekker quoted Dr. Wallace's views accepting his conclusion as "on the whole, a very probable explanation of the facts of the case."[1] Without entering into the biological evidence, Dr. Wallace's opinion was as follows:

> [In Miocene times] Java would have been at least three thousand feet lower than it is now, and such a depression would probably extend to considerable parts of Sumatra and Borneo, so as to reduce them all to a few small islands. At some later period a gradual elevation occurred which ultimately united the whole of the islands with the continent. . . Java was then separated by subsidence. . . A little later the subsidence may have extended farther north, isolating Borneo and Sumatra, but probably leaving the Malay Peninsula as a ridge between them as far as the islands of Banca and Biliton. Other slight changes of climate followed, when a further subsidence separated these last-named islands from the Malay Peninsula[2] . . .

More recent work has thrown further light on this subject. Thus Mr. H. C. Robinson says:

> It is therefore, I think, fairly evident that at some comparatively recent time a barrier has existed between the mountains of Southern Selangor and their continuation in Negri Sembilan, sufficient to prevent the extension of the dominant continental and Sumatran forms southwards. It is evident, also, that this barrier must have been a substantial one, as wide stretches of low country separating the Gunong Tahan Ranges from the backbone of the Peninsula have not sufficed to effect any specific differentiation in the fauna of the two ranges.[3]

Again, Mr. H. N. Ridley in 1916 wrote, concerning the flora of Kedah Peak, that it resembled that of Mt. Ophir,

> especially in the occurrence of lowland seashore plants, isolated as they are from the ordinary habitats of these plants by the forest that lies between them and the sea. . . There can be little doubt that Mount Ophir was at one time an island detached from the mainland as Penang is to this day, and it seems highly probable that Kedah Peak may have been similarly isolated.[4]

More recently Mr. C. Boden Kloss writes:

> The northern limit of the true Malaysian flora, which covers the southern half of the Malay Peninsula, Sumatra, Borneo and—to a less extent—Java, and of which the conti-

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[1] R. Lydekker: A Geographical History of Mammals, Cambridge, 1896, pp. 302, 303.

[2] A. R. Wallace: Island Life, New York, 1881, pp. 353–354.

[3] H. C. Robinson: A List of a Small Collection of Mammals and Birds from the Mountains of Ulu Langat, Selangor, *Journ. Federated Malay States Museums*, Vol. 4, 1909–11, pp. 235–241; reference on p. 241. Kuala Lumpur.

[4] *Ibid.*, Vol. 7, 1916, p. 37.

nental section may be called Malayan, seems to be a line joining the towns of Alor Star (in Kedah) and Singgora (at the entrance to the Inland Sea).

Botanical features confirm what geological investigations indicate—that this boundary was the coast line of what was once an island but what has since become the southern half of the Malay Peninsula.[5]

I would call this Alor Star-Singgora line a major transverse break in the Malay Peninsula and am inclined to think that there is another between Bandon and Pangnga, and perhaps Bandon and Trang.

These opinions indicate that the "further subsidence" mentioned by Wallace as separating Banka and Billiton from the Peninsula, may have gone farther than was necessary to produce the present configuration. I am convinced that was so and that the subsidence continued sufficiently to reduce the southern part, at any rate, of the Peninsula to a group of islands, that is part of the Archipelago. We know from raised beaches that there has been a very recent elevatory movement. I will give my reasons later for considering the final movements were (1) subsidence, reducing the Peninsula to a group of islands; (2) elevation, probably continuing today, that brought the Peninsula to its present condition.

Summarizing this period of land movements then, we have:

1. The elevation of a group of small islands scattered over a wide area, on the present site of the Archipelago and Peninsula, to form part of the mainland of Asia.
2. The separation of Java by subsidence.
3. The separation of Borneo and Sumatra by subsidence.
4. The separation of Banka and Billiton from the Peninsula.
5. Submergence of a large part of, if not all, the Peninsula to form a group of islands.
6. Elevation of these islands to re-form the Peninsula.

Coulisses

The Malay Peninsula is but a small part of a large region that is thus described by Suess:

In this way the mighty swell of the Altaides in Thibet subsides and is dispersed. The whole continent becomes lower. Many coulisses disappear. Only a few long branches are continued: on the east into the cordillera of Annam; on the west, always giving rise to fresh coulisses, through the Malay Peninsula, and still further, to Java and beyond.

We have now arrived at one of the most instructive parts of the earth's surface. Four elements combine to form it: the end of the Burman arc, the southern branches of the virgation of the Philippines, the spurs of the great cordillera of New Guinea, and finally the continent of Australia, with the cordillera which marks its eastern border and crosses Torres Strait.[6]

The word "coulisse" here means prominent features arranged *en échelon* on the earth's surface like the wings of the stage in a theatre. Such features

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[5] *Ibid.*, Vol. 10, Part II, 1920, p. 79.

[6] Eduard Suess: The Face of the Earth, Engl. transl., Oxford, 1908; reference in Vol. 3, pp. 231–232.

are formed by folding of the stratified rocks and the intrusion of masses of igneous rocks, followed by erosion.

Suess describes a granite coulisse as becoming the Lakawn Range, entering the Peninsula and thence onwards representing its axis. This description was based on material collected when little was known of the Peninsula; and one object of this paper is to show how the Lakawn, or Nakawn, Range is succeeded by several other coulisses *en échelon*, which

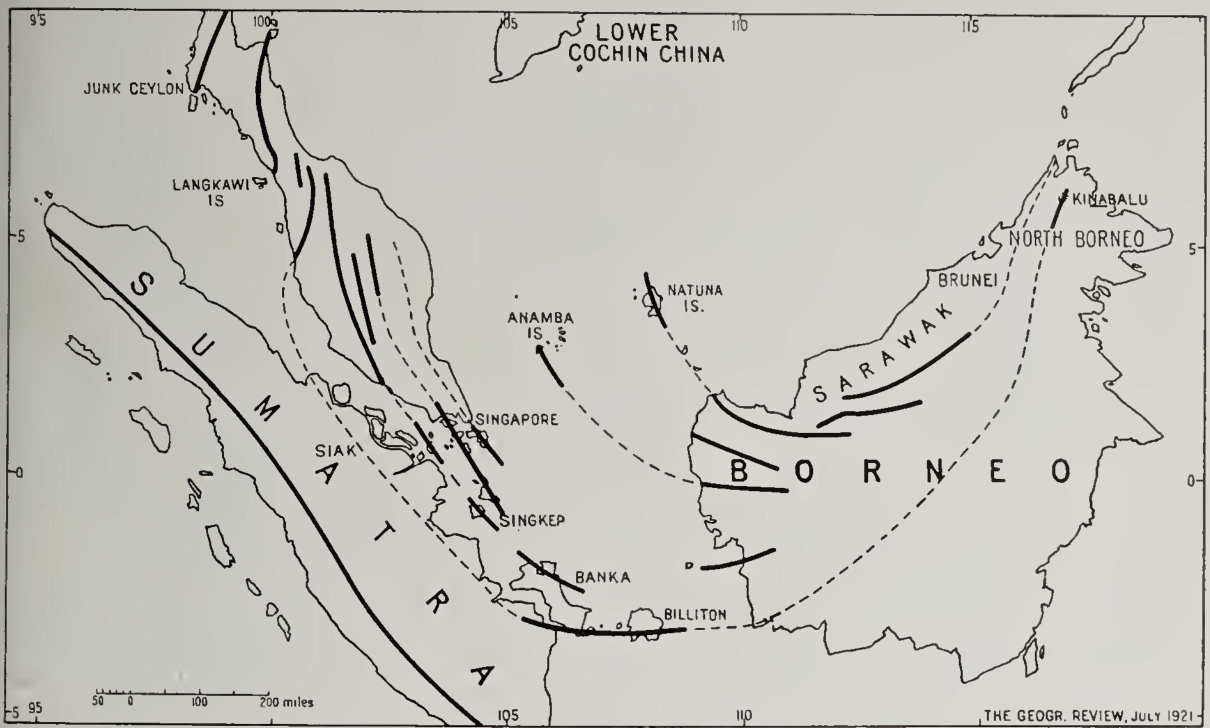

FIG. 1—Sketch map showing the probable connection of "coulisses" in the Malay Peninsula and Archipelago.

together form the skeleton of the Peninsula as defined above, and to trace the probable continuations of these coulisses into the Archipelago where they join coulisses described recently by Mr. Van Es.[7]

Nakawn Coulisse

The maps, Figures 2 and 3, show in some detail the main features of British Malaya, but before discussing them I would refer to the smaller map, Figure 1 on p. 355, for a moment. In the part of the continent north of the Langkawi Islands two coulisses are marked, the westerly one ending near Junk Ceylon, the easterly being, in the central portion at any rate, the Nakawn Range, which Suess described as entering the Peninsula and representing its axis. Field work in Perlis has given me some knowledge of the southern part of this coulisse, and I have good reason for believing that its true course is as represented; that is, on reaching Perlis, it bends slightly to the west of south and reaches the sea near the Langkawi Islands.

[7] L. J. C. Van Es: De tektoniek van de westelijke helft van den Oost-Indischen Archipel, *Jaarboek van het Mijnwezen in Nederl. Oost-Indië*, Vol. 46, Part II, 1917, pp. 5–143. The Hague.

Turning to Figure 2 we see the termination of this coulisse on a larger scale (No. 1). It forms the boundary between Perlis and Setul. In the north of Perlis granite occurs in it, but elsewhere this boundary range

FIG. 2—Key map of British Malaya showing coulisses. The coulisses are represented diagrammatically by bands of shading. They are not in every case continuous mountain ranges (compare Fig. 3 opposite). References to numbers are: (1) Nakawn Coulisse, (2) Kedah-Singgora Coulisse, (3) Gunong Perak, (4) Kedak Peak, (5) Penang, (6) Granite hills of Province Wellesley, (7) Bintang Coulisse, (8) Kledang Coulisse, (9) Kerbau Coulisse, (10) Benom Coulisse, (11) Mt. Ophir, (12, 13) Tahan Coulisse, (14, 16) East Coast Coulisse, (15) Blumut Range.

consists of rugged limestone hills, which one finds again on the east coast of Langkawi Island, the center of the island being granite. I have climbed hills on and near the northern border of Perlis between coulisses 1 and 2

to search for any continuation of this Nakawn Range into the Malay States to the southeast; but, although it should be plainly visible, I could not see one. Through the supposed site of it a railway has been constructed

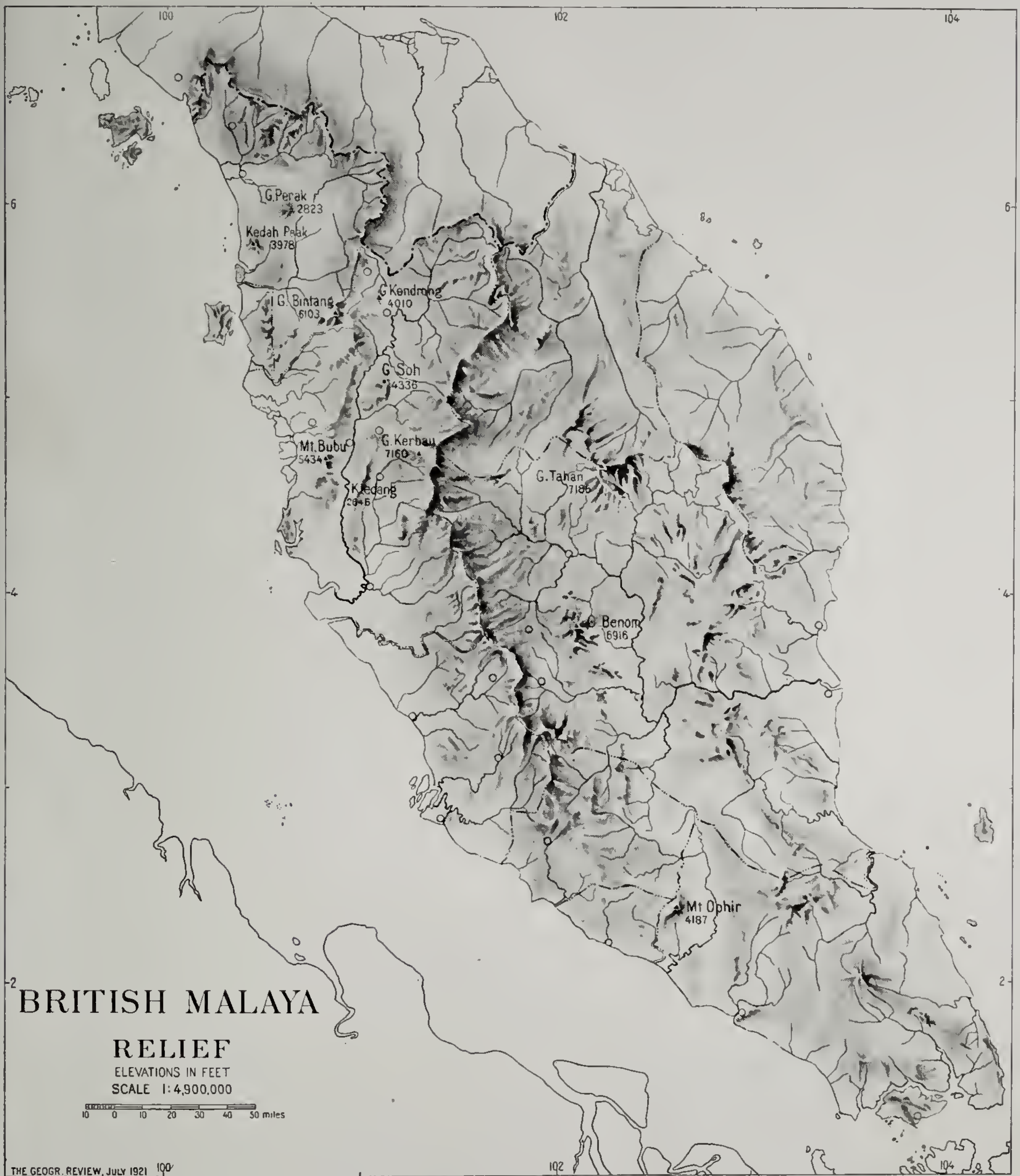

FIG. 3—Relief map of British Malaya based on the F. M. S. Government Survey Map of 1913. For locations and river names see the map opposite, Figure 2.

without difficulty, not to mention an earth road; while the watershed between Perlis and the Siamese territory to the north is for a large part only about 300 feet high. My own observations are corroborated by others who have been farther into Siamese territory than I have. There can be no question that the Nakawn Range does not enter the Peninsula as its

Fig. 4

Fig. 5

Fig. 4—Sketch from a photograph, looking eastward, showing the low watershed between the state of Perlis and Siamese territory. The dotted line indicate the approximate position of the watershed. Padang Besar, a railway station on the border is seen in the middle distance. The range of hills in the far distance is the Kedah-Singgora Coulisse.

axis, but the statement that it does so will die hard and will probably be quoted for many years to come among those who do not know the ground.

Kedah-Singgora Coulisse

The land between the end of the Nakawn Coulisse and the Kedah-Singgora Coulisse (2) is low-lying. In Perlis and Kedah it is extensively cultivated for paddy, and from the broad stretches of the rice fields isolated limestone hills rise abruptly. In Perlis these limestone hills form a double chain stretching through the center of the state, the first being about eleven miles inland from the present coast. Other limestone hills are found in Kedah, at Kohdiang, and near Alor Star where Elephant Hill is a well-known feature in the landscape.

The Kedah-Singgora Coulisse is formed of hills rising above 2,000 feet and composed chiefly of quartzite and shale. At least one granite outcrop is known. Almost due south of its southern termination is an isolated mountain (3), Gunong Perak; and to the southwest of this again is Kedah Peak (4), or Gunong Jerai, another isolated mountain, 3,978 feet high and composed of quartzite with granitic intrusions. On the eastern border of Province Wellesley are small granite hills (6). Penang Island (5) also is granite.

Bintang Coulisse

East of the Kedah-Singgora Range the boundary of Kedah and Siamese territory is hilly, but the peaks are highest where the border turns sharply southwards. Their composition is unknown to me; but southwards and across the headwaters of the Muda River they are continued as the first large and purely granite range in British Malaya (7). It contains two fine peaks, Bintang (6,103 feet) and Bubu (5,434 feet). I propose to call this the Bintang Coulisse. South of Taiping these granite hills break down for a space and then reappear in the Dindings and Pulau Sembilan (Nine Islands). West of Pulau Sembilan is another granite island, Jarak, which I have recently visited. East of the Bintang Coulisse is the Perak River valley in British territory and, in Siamese territory, the River Patani. The watershed between these rivers close to the Bintang Coulisse is only a little over 1,000 feet. Grik, close to the Perak River, is only 380 feet above mean sea level, but the country through which the river flows until it reaches Kuala Kangsar is all hilly and affords some of the finest tropical scenery imaginable. The hills are of quartzite and limestone lying on a granite platform, but close to the river is a well-marked granite range (8), cut through by the Plus north of Sungei Siput, in which the best-known peak is Kledang near Ipoh (2,846 feet). The highest, however, is Gunong Soh (4,336 feet) north of the Plus. The granite of this range is covered by quartzite in the southern part.

Kerbau Coulisse

To the east of the Perak River is the Main Range (9), or Kerbau Coulisse (Gunong Kerbau, 7,160 feet), formed of granite with some sedimentary rocks high up among the granite hills. This range is the most striking feature of the Peninsula and has five peaks over 7,000 feet grouped near the Kelantan-Pahang border. The mountains decrease in height as one follows them south until they die away in Malacca.

Although I have been nearly to the headwaters of the Perak, I know very little of the northern end of this range. From a hill at Intan, north of Grik, I have looked down the broad Patani valley and can only say that the Main Range must end somewhere between the Patani and Telubin Rivers in Siamese territory.

Between the Main Range and the Kledang Coulisse (8), the watershed between the Plus and Kinta Rivers is very low (271 feet). To the south of Ipoh rolling country merges into an extensive alluvial flat extending along the coast as far as Negri Sembilan, from which rise here and there little hills of quartzite and granite. Nearer the Main Range is an extensive belt of low quartzite hills not indicated on Figure 1.

Benom Coulisse

To the east of the Main Range, which is distinctly ex-centric in its position, lies the greater but less developed part of British Malaya. Two metalled roads, from Kuala Kubu and Kuala Lumpur, enable one to travel easily over the Main Range into Pahang. Flanking the granite hills on the east is a much lower range of quartzite foothills near Raub and Bentong, and east again of these is a belt of comparatively low-lying country, composed chiefly of calcareous rocks, which terminates abruptly against the Benom Coulisse (10) in which Benom is the only high mountain (6,916 feet), situated between the Jelai and Semantan Rivers. This coulisse also is granitic but rich in hornblende. Northwards its continuation is marked by inconspicuous granite outcrops. To the south the Semantan cuts through rocks found in the Benom massif, while there are further outcrops extending into Negri Sembilan. Mt. Ophir (11), 4,187 feet high, may be a prolongation of the Benom granite, and the same may be true of granite hills near Kuala Pahat; but the separation of these outcrops from the Kerbau Coulisse in Negri Sembilan and Malacca is open to question.

Tahan and East-Coast Coulisses

On the east of the Benom Coulisse, and separated from it by the Pahang River valley, is the Tahan Coulisse (12). On the Kelantan border this is marked by the highest mountain in the Peninsula, Gunong Tahan (7,186 feet). It is of quartzite and altered shaley rocks which are continued southwards as a well-marked belt, rising, however, to no great altitude. South

Fig. 6

Fig. 7

Fig. 6—Gunong Tahan (7,188 feet) from an altitude of about 5,000 feet. (Photograph by C. Boden Kloss.)

Fig. 7—Cliffs near Gunong Tahan. This and Figure 6 show the open nature of the country here at an altitude of about 5,000 feet. A poor soil and the northeast monsoon have checked the growth of the usual luxuriant vegetation. (Photograph by C. Boden Kloss.)

of the Pahang River little is known about this belt, but granite and quartzite extending into Singapore Island appear to mark an extension of the coulisse (13).

To the east of the Tahan Coulisse again is one still more indefinite in its southern portion. This (14), the East-Coast Coulisse, is known in the north as a broad tract containing high mountains, believed to be mainly of granite. Detached granite and perhaps quartzite hills in South Pahang and Johore (15 and 16) mark its probable extension. This coulisse contains several areas of tin-bearing granite, and it is a reasonable conjecture that here denudation has laid bare the highest portion of a long tin-bearing granite ridge similar to the granite of the Main Range. Both 12 and 14 extend northwards farther than is indicated on the map, but I have no first-hand knowledge of them beyond the points marked. On the River Tekai quartzite hills, which are regarded as part of the Tahan Coulisse, are a well-marked feature; and in the headwaters of the Tembeling River the country between the Tahan and East-Coast Coulisses is also hilly.

Harmonious Structure of the Archipelago and Mainland

The Benom Coulisse is well marked between the Semantan and Jelai in Pahang, and the Kerbau and Bintang Coulisses to the west are well marked over almost the whole of their course; but the same cannot be claimed for the Tahan and East-Coast Coulisses. When we turn to the Archipelago, however, we find strong support for the courses indicated. In his recent paper Mr. Van Es, working, I believe, without any knowledge of the details of Peninsular geography, traced on a map of the western part of the Netherlands Indies the coulisses revealed by the study of its natural features. These are reproduced on a small scale in Figure 3, on which I have also indicated the Peninsular coulisses. Thus a coulisse in the islands southeast of Singapore carries on the line suggested for the East-Coast Coulisse. Another, with a longer course, prolongs the line of the Tahan Coulisse. The coulisse passing through Singkep and the north of Banka, if produced, joins on to the Kerbau Coulisse, or Main Range. The Bintang Coulisse may, without violating the harmony of the general structure of this large area, be connected, through the Aroa Islands (see Fig. 1), where quartzite is known, to the great sweeping curve of the coulisse that Mr. Van Es marks as passing Siak, the south of Banka, Billiton, the center of Borneo and ending in North Borneo a little beyond the great granite mountain Kinabalu (13,698 feet). It will be noted that the curve suggested for this coulisse through the Straits of Malacca is harmonious with the curve of the Kerbau Coulisse. I doubt if two independent workers could have more striking confirmation of their ideas than that afforded by the manner in which the coulisses I believe to exist in the Peninsula join up with those Mr. Van Es believes to exist in the western part of the Archipelago.

General Character of the Peninsula

These coulisses form the framework of the Peninsula: they mark the lines along which rocks have been folded, hardened, and altered by intrusive igneous masses. An observant traveler, however, will first notice a general feature of the geography, which is that the Peninsula is for the most part a low-lying tract of land from which mountain ranges and isolated hills rise abruptly. How low the general surface of the land is can be gathered from the fact that Raub, close to the Main Range and between the headwaters of the Semantan and Lipis Rivers, these being tributaries far up the Pahang River, is only 462 feet above sea level; Bentong, to the south of Raub, only 321 feet; and Grik, far up the Perak River, 380 feet.

He would notice, too, the extraordinary course of the Pahang River and one of its tributaries, the Tembeling. The latter rises in the East-Coast Coulisse and flows to the west. It then turns south to join the Pahang which continues the southerly course for some way and then, turning sharply through more than a right angle, cuts through low quartzite hills of the Tahan Coulisse and flows eastward to the China Sea.

Moreover, if he were to follow up the Bera and Serting from this sharp bend in the Pahang, he would pass over very low country into Negri Sembilan; it is possible to convey a native boat without much difficulty from a tributary of the Serting overland into a tributary of the Muar and so reach the Straits of Malacca, the watershed between the Serting and Muar being inconspicuous. The actual height of the watershed is given by Mr. T. A. Kitching, of the Federated Malay States Survey Department, as 180 feet. A slight depression, therefore, in Negri Sembilan would divert the Pahang from its present course into the Straits of Malacca approximately along the present line of the Muar.

The Rivers

It is on the rivers that one can best enjoy the beautiful scenery of the Peninsula. The two chief rivers, the Pahang and Perak, vie with each other in this respect. The Pahang is perhaps the more beautiful in its lower reaches, broad and shallow, studded with sandy islands. The Perak excels in its upper reaches, flanked by virgin jungle, full of rapids, narrow, and tumultuous. The Pahang is navigable far above Kuala Lipis; but in the Tembeling and the headwaters of other tributaries there are bad rapids.

Owing to the steep rise of the mountains from the lower land the profiles of the rivers flowing down from them form sharp curves. In the hills the grade is of course steep, and there is little opportunity of depositing the load of detritus. On reaching the foot of the hills, however, the grade suddenly decreases, and detritus is deposited to form alluvial flats.

FIG. 8—The luxuriant Malayan vegetation. A road through quartzite hills in Pahang.

The Granite Hills

There are three distinct types of hills: granite, quartzite, and limestone. The granite hills are not confined to the coulisses shown on the map. Thus between 6 and 7 there are granite hills; and also between 7 and 9, to the east of Grik. There is evidence that in Kedah and the north of Perak the main mass of granite to which the granite coulisses are connected comes very close to the surface and that the covering of bedded rocks is consequently thin. The main mass of granite seems to lie deeper, however, east of the Kerbau Coulisse: I have suggested above that the East-Coast Coulisse may mark the summits of a granite ridge like the Kerbau Coulisse, but only just laid bare by denudation.

In Selangor there are two isolated granite hills that are now familiar landmarks: one, with an old Dutch fort crowning it, at Kuala Selangor; the other at Jugra, Parcellar Hill. It is perhaps worth noting that if the line of the Kledang Coulisse (8) is produced so as to curve in the same way as the Kerbau Coulisse (9), it will pass near these two hills.

The depth to which the granite weathers to a soft sandy clay and possibly other causes lead to the outlines of the granite hills being, for the most part, smoothly curved: precipices are rare, and even at altitudes over 6,000 feet the vegetation is luxuriant, so much so that one rarely obtains an extended view without felling trees. Most of the high granite peaks (the actual summit of Kerbau, I should mention, is formed of sedimentary rocks, not granite) have been cleared at one time or another for surveying purposes and have become covered again with a growth of secondary jungle, which is much worse to penetrate than virgin jungle and quite impossible to see through.

A noteworthy feature of the granite hills is the manner in which parts of the rock resist weathering and form "core boulders" that have the appearance of being waterworn. They are sometimes of great size, large enough to allow men to camp under a projecting side.

Quartzite Hills

The quartzite mountains that I have ascended are Tahan, 7,186 feet; Kendrong (close to Grik), 4,010 feet; Kedah Peak, 3,978 feet; and Bongko, a little east of Benom in Pahang, 2,860 feet. Although the vegetation makes the ascent of any mountain here an easy matter compared with what it would be were there no tree trunks, branches, and roots to pull oneself up by, I know from experience that the quartzite mountains are less easy to ascend than the granite. Bedding and jointing in the rock make precipices of frequent occurrence. On the summit of Kedah Peak there is one that must be over a thousand feet high. Below the summit of Tahan the Tiku River flows through a precipitous gorge that might be called a canyon. Kendrong, which rises from country only about 500 feet high, is steeper than anything else I have climbed

and would, I think, be impossible to all but practiced mountaineers, were it not for the vegetation.

In the northwestern corner of Langkawi Island there is a long junction between granite and quartzite. The latter has withstood weathering better than the granite and now forms a long serrated ridge with peaks over 2,000 feet high and precipices facing towards the granite, which does not rise to the same height.

Limestone Hills

Limestone hills occur in the Langkawi Islands, Perlis, Kedah, Perak, Selangor, Pahang, and I have seen some in Kelantan from the Pahang border. There are none in Negri Sembilan or Malacca; concerning Trengganu and Johore in this respect I have no information. On the mainland they are best developed in Perlis and the Kinta District of Perak. In Kinta they cover a considerable acreage; but both there and in other parts one finds isolated hills rising sharply from the surrounding country, often bounded by vertical or even overhanging cliffs.

When traveling by train through Perak one obtains a good view of the Kinta limestone hills and also of Gunong Pondok, an isolated hill between Kuala Kangsar and Taiping. This hill is 1,860 feet; in Kinta, Nasi Sehabat is 2,005 feet. Sinyum, one of the isolated hills in Pahang not far from Temerloh on the Pahang River, is 1,595 feet.

The boundary range between Perlis and Setul, as already mentioned, is limestone.

In the Langkawi Islands white limestone cliffs and islets of limestone with perpendicular sides undercut by the sea, rise out of the water just as they rise from low ground on the mainland. Were Perlis and the Kinta District flooded by an invasion of the sea the type of scenery would be identical with that of the Langkawi Islands.

As would be expected in this warm and rainy country, the limestone hills are honeycombed with caves, some of great size and beauty. Enclosed hollows shut in by high cliffs also occur. In Perlis such a hollow is known as a "wang." One of them, Wang Tangga (the Ladder Wang—so called because it is entered by a steep climb up steps on one side of a limestone cliff and an equally steep descent on the other), is large enough to contain a Malay village with paddy fields. Some of the caves in Perlis and Kinta contain payable deposits of tin ore. In Selangor one long, dark cave contains a very interesting but uncanny fauna, including large toads, spiders, and white snakes. The last are said to be harmless and only a bleached variety of a common non-venomous snake; but a friend of mine who was bitten by one was laid up for a fortnight with blood poisoning.

Evidence of a Marked Subsidence

The above description of the main features of the Peninsula is very brief and, I fear, unsatisfactory, because necessarily incomplete. There are

enough data, however, to justify our inquiring if any connection can be traced between the present-day features and the succession of earth movements detailed earlier in this paper.

FIG. 9—A limestone cliff in the Kinta District. The distant range is the Kledang Coulisse with limestone hills at its foot.

In the first place, are the existing rivers responsible for the contrast of low-lying land and high ranges and isolated hills rising abruptly from it? To take a particular case, if this is so, then the Kinta River, an insignificant stream, has carved out a huge trough to within 300 feet of sea level between the Kledang Coulisse (Kledang 2,846 feet) and the Kerbau Coulisse (Kerbau 7,160 feet). This I cannot regard as likely. It is perhaps impossible to prove anything, but I will suggest what the course of events may have been.

The high ranges show evidence of great denudation; and, if we assume that that denudation began when the Archipelago was joined to the mainland and the whole surface was higher than it is now, we have a sufficient time interval in which the denudation could be effected. In other words, these ranges and hills are not modern features of a peninsula, but relics of the time when the Archipelago and the Peninsula were one and the river system was more powerful than now. On that mainland the present site of the Peninsula would be a wild mountainous tract, higher than now, where the river system began the work of carving out the hollows between the coulisses.

But when the subsidence set in marine denudation came into play and at the extreme limit of this movement, i. e. when the Peninsula itself was separated as a group of islands from the mainland of Asia, would have planed down a large part of the valleys formed by the old continental rivers. A depression of 500 feet below the present sea level would cover a very large part of the existing land. Grik would be under the sea; the part of the Kledang Coulisse between the Plus and Telok Anson would be an island. The Pahang River valley, Raub, and Bentong would be submerged. The granite, quartzite, and limestone hills would form a multitude of islands and islets. The biological evidence is strong enough for us to assume some such marked subsidence took place.

Results of Marine Denudation

When the elevatory movement that was to restore the Peninsula set in again, the old continental valleys would have been to a large extent modified by marine denudation, and the new drainage system would flow over the remnants of the continental ranges, such parts of the continental valleys as had not been submerged, and a plain of marine denudation. The remnants of the continental ranges have been described. The headwaters of the Perak River above Grik, the upper reaches of the Jelai above Kuala Lipis, and the headwaters of the Tembeling may represent unsubmerged portions of old valleys, but unfortunately we do not know and cannot expect to know exactly how far submergence went. The plain of marine denudation may, I think, be recognized in Perlis and the low watershed between Perlis and Siam, in the lowlands of Kedah, dotted with little hills, in the watershed between the Plus and Kinta Rivers and the low country on either side of it between the Kledang and Kerbau Coulisses, and in much of South Perak, Selangor, and Pahang. In the last state I would emphasize one locality, the Pahang-Kelantan watershed immediately to the west of the Tahan Coulisse (8). This watershed is also the state boundary; but because it is so low and indefinite the boundary has not yet been accurately fixed. I have been to the place and have had good views of both sides of the watershed from Gunong Tahan and from a limestone hill close to the boundary. It has been selected as the route for a new railway now

under construction into Kelantan, and the Chief Resident Engineer for Construction of the Federated Malay States Railways informs me that the height of the railway on the boundary will be 628 feet. It is curious that this point, halfway across the broadest part of the Peninsula, should be so low and so close to Tahan, the highest mountain (7,186 feet); but if we admit the possibilities of marine denudation, it can be understood.

There are two factors that may have made the present drainage depart from the lines of the old continental drainage; one, the formation of new ridges by the irregularities of marine denudation; the other, the breaching of the island ranges by the same agency. On the west of the Main Range (6) a combination of both may account for the present courses of the Plus and Kinta Rivers. Let us suppose that in the continental stage, when the Archipelago was united to the mainland, there was no gap in the Kledang Coulisse through which the Plus could flow and that the Plus flowed south between 5 and 6, joining the Kinta. When the sea advanced up the Perak valley it may have broken through the Kledang Range on the site of the present Plus River and eroded the land on the other side towards the site of Sungei Siput. At the same time the sea would have advanced from the south between the Kledang and Kerbau Coulisses. Ultimately the two arms of the sea would meet making the southern part of the Kledang Coulisse an island. Then, when the sea retreated again, the Plus would flow through the breach made by the sea to join the Perak, and a low watershed would be left between the Plus and the Kinta.

Explanation of the Course of the Tembeling and Pahang Rivers

The course of the Tembeling and Pahang Rivers has been noted, and the following suggestions are now made to explain it. In the continental stage the Pahang River flowed between the Benom and Tahan Coulisses and continued its course in a south-southeasterly direction over the present drainage of the Muar. When the sea advanced it broke through the Tahan Coulisse east of the site of Temerloh, giving a new channel for the Pahang when it retreated again, reversing part of its southern drainage (now the Bera and Serting), and leaving a low watershed between the Serting and Muar. Similarly marine denudation, which could not break down the mass of Gunong Tahan, may have broken down the coulisse to the south of Tahan sufficiently to allow the Tembeling to flow through it; but this part of Pahang requires more detailed study. Another possible explanation that I have put forward for the present course of the Pahang, is that a stream flowing east from the Tahan Coulisse cut its way back and captured the Pahang, thus diverting it to the China Sea. Unfortunately, however, no stronger evidence than the general lie of the land now can be cited as evidence in support of either explanation. The dense jungle hides old river terraces, if such exist, and we can only say that either event would

account for the present course of the Pahang River and the low watershed (180 feet) to the south.

Marine Deposits and Raised Beaches

It may be objected that, if this submergence of the Peninsula took place, marine deposits laid down during that period should be visible now. In this respect there is very little positive evidence. Although on the neighboring island of Sumatra late Tertiary rocks are well developed, on the Peninsula as defined in this paper only three small patches are known; one in Selangor with coal, plant, and land-shell remains; another near Kuala Kangsar with limestone underlying a coal seam; and another on the Perlis-Siam border. There is good evidence of their being Tertiary but no means of determining whether they were deposited in the period of uplift in Miocene times that led to the Malay Archipelago being united to the continent of Asia or in the subsequent period of subsidence. The limestone near Kuala Kangsar points to marine conditions, of which there is no evidence in the other two patches; and it may have been formed when the sea converted the southern part of the Kledang Coulisse into an island.

In Kinta, certain high-level gravels may possibly have been laid down before the period of subsidence; but, whether this was so or not, any Tertiary deposits must have been subjected to considerable denudation after the sea retreated.

Apart from the biological evidence in the Peninsula, however, we must remember that movements which affected the area of the present Archipelago can hardly have failed to affect the area of the present Peninsula, so close are they one to the other; and for the last period of movement, which seems to be in progress still, that is the uplift which restored the Peninsula, we have more satisfactory testimony. At several localities near the coast raised shell beaches are found. I have seen them at the foot of Elephant Hill (between Alor Star and the sea, in Kedah), near the mouth of the Perak River, and near the mouth of the Bernam River. Mr. Leonard Wray says, "In a search for shell mounds in Lower Perak some interesting facts bearing on the formation of the coast and the valley of the Perak river were brought to light. At Pasir Panjang, Laut, there are no less than seven lines of old beaches, and between each there is a piece of low-lying land now used as padi fields."[8] From Kuala Selangor one can see a line of high land now far removed from the sea that has the appearance of an old coast line; while on Langkawi Island large stretches of sea sand in the interior of the island show that there must have been an actual uplift and that the sedimentation of the rivers is not the only factor concerned in the growth of the land.

In Perlis I found marine mollusca in a cave eleven miles inland and nearly 300 feet above sea level. This I have cited elsewhere as evidence of

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[8] *Perak Museum Notes,* Vol. 2, Part I, p. 71.

uplift; but since doing so I have seen accumulations of shells in Langkawi that make me admit that, although these Perlis shells were buried in phosphate, they might have been taken to the cave by human beings.

The raised beaches are only about 50 feet above sea level. Unfortunately calcareous matter dissolves so quickly that one cannot expect shell beaches at great elevations, so that their absence farther inland and higher above sea level does not mean they never existed.[9]

On the east coast certain inland ridges, locally named "permatang," are believed to be old shore lines.

The similarity between the existing islands off the west coast and isolated hills rising from the coastal plain strongly suggests that the latter were quite recently islands in the sea, and in this regard we must not altogether despise native tradition. The idea that an inland hill was originally a ship navigated here by a Malay certainly does not inspire much confidence as evidence; but a legend that men from Acheen once attacked from boats a place now about seven miles inland on the Perlis-Kedah border, commands some respect.

There is no question that parts of the west coast are extending seawards today, e. g. the land at the mouth of the Kedah River; but, taking that case alone, deposition of sediment brought down by the river might account for the growth. The raised beaches, however, show that there has been an uplift as well.

Similarity of Islands and Hills

A journey by sea from Penang to the Langkawi Islands gives a strong impression of the close similarity of the islands and hills on the mainland. Penang is separated from Province Wellesley by a shallow strait. A slight elevation would make of Penang Island a hill much like Kedah Peak, clearly visible beyond the harbor. As one approaches the Langkawis, having passed several islets which have their counterparts rising from the Kedah paddy fields, the isolated limestone hills of northern Kedah and Perlis are seen rising from a flat, low plain, just as some of the Langkawi islets ahead of the ship rise from the sea.

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[9] Mr. Boden Kloss informs me that he has seen old beaches at greater elevations than 50 feet.

AN EXPLORATION OF THE RIO DE ORO, COLOMBIA-VENEZUELA

By H. Case Willcox

[With separate map, Pl. VII, facing p. 382]

In the Republics of Colombia and Venezuela there exist large territories virtually unknown even within short distance of highways of communication. Regions trodden by the *conquistadores* in the earliest days of the discovery remain the haunts of savage tribes. This is the case in the Opón valley. Although this valley lies within sight of the Magdalena and was ascended by Quesada in 1536, a journey through it today is described as attended with no little risk. Farther north the Motilone Indians of the Sierra de Perijá close a long stretch of country on the Colombia-Venezuela boundary. Already before Quesada's expedition Alfinger had crossed the Sierra on his way from Lake Maracaibo to the César valley. We know little more of it today.[1] Some fifty years ago the Colombian government attempted a forcible "civilization" of the Motilones. The sole result was to provoke attack on the adjacent settlements (Valle de Upar) and to close the only trail across the Sierra de Perijá into Venezuela.

A special interest, however, attaches to this portion of the Colombian Andes. About Pamplona (latitude 7° 20′ N.) the Eastern Cordillera divides into a northeastern branch, the Venezuelan Andes, and a northern branch that dies out in the Montes de Oca. The northern branch constitutes the divide between drainage to Lake Maracaibo and the Magdalena, and in part (Sierra de Perijá) it forms the boundary between Colombia and Venezuela. The earliest boundary treaty between the two republics (1833) defined this section of their common boundary as:

> . . . the crests of the Montes de Oca and by these crests and those of the Perijá mountains until they meet the head-waters of the Oro River . . . the waters of this river downstream to its confluence with the Catatumbo.

The Sierra de Perijá has remained unknown, and no boundary disputes have arisen in connection with it. The above line was confirmed in the King of Spain's award (1891) but it has not yet been demarcated.[2]

A word must be said as to the usage of the term Sierra de Perijá. Locally the name is restricted to the eastern or Venezuelan side of the chain. On the Colombian side different sections go under different names. The more

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[1] Wilhelm Sievers: Die Sierra Nevada de Santa Marta und die Sierra de Perijá, *Zeitschr. der Gesell. für Erdkunde*, Vol. 23, 1888, pp. 1–158; reference on p. 113.

[2] On November 3, 1916, a convention was signed between Colombia and Venezuela which provided that the President of Switzerland should act as arbiter for such portions of the boundary as are in dispute. A dispatch from Geneva dated May 10, 1921, announces that the Swiss Federal Council will arbitrate the dispute and that the necessary surveys will be made by Swiss engineers.

southerly portion is known as the Sierra de Motilone, and its southward continuation is termed the Cerro (or Cerros) de Bobali and the Sierra de Ocaña. This usage has been discussed in the article "An Exploration of the Sierra de Perijá, Venezuela" by the late Theodoor de Booy.[3] In 1918 Mr. de Booy conducted an expedition into the Sierra from the Venezuelan side about latitude 10° 30′ N. Farther south explorations have been carried on by various oil companies interested in the Barco Concession. This concession is described in the deeds as lying south of the Rio de Oro and between the Catatumbo River on the east and the Cerro Bobali and Sierra de Ocaña on the west. These explorations included a certain amount of work on the Rio de Oro not far from the petroleum wells and on the western flank of the Sierra Motilone and about the Cerro Bobali.

In 1920 the writer crossed the chain in reconnoitering on behalf of the Carib Syndicate for a route feasible for a railroad and pipe line from the navigable waters of the Magdalena to the petroleum wells which are situated on the Rio de Oro near its junction with the Catatumbo. A brief account of the expedition will now be given.

Explorations on the Western Side of the Sierra Motilone and Cerro Bobali

In June, 1920, I started from Cartagena in company with Mr. M. J. Bolan,[4] a railroad contractor and explorer, proceeding via Calamares by the Cartagena-Calamares railway (of which the major portion was constructed by Mr. Bolan in 1892) and up the Magdalena River to El Banco, a town of 4,000 population at the junction of the Magdalena and César Rivers. From El Banco we went up the Rio César, across Lake Zapatosa and landing at Soloa proceeded to Curumani in the foothills of the Sierra de Motilone where some investigations were made of the Rio Animito valley. We then returned to the Magdalena at Tamalameque, some miles above El Banco. Were communications available Tamalameque would serve as the outlet for Cúcuta and other interior towns of the department of Santander Norte which must now find their markets in Venezuelan territory. Various projects have been advanced for opening up such communications. Among them is the cattle trail constructed in 1885 but abandoned shortly afterwards. As we subsequently proved, even knowledge of its course had been lost. From Tamalameque we followed it for 67 miles, passing around the western shoulder of the central member of the three Cerro Bobali peaks at an elevation of 6,750 feet and climbing down four and a half miles on the other side and into the Barco Concession at an elevation of 5,000 feet. At this point it became clear that the route was not feasible for any type of

[3] *Geogr. Rev.*, Vol. 6, 1918, pp. 385–410.

[4] Mr. Bolan, who has had 30 years' experience in western South America, organized and equipped my expedition and was directly responsible for its success. His knowledge of the language, customs, and racial traits of the natives was invaluable in securing local co-operation.

Fig. 1

Fig. 2

construction, and we turned our attention to the central and northern peaks of the Cerro Bobali. I measured their height by the boiling water method and found them to be 7,750 feet and 7,928 feet respectively. The northern peak, the highest elevation within a radius of 50 miles, is plainly visible to the traveler in fair weather while journeying on the Magdalena River at a distance of possibly 100 miles.

A few weeks later we made a partial exploration of the Colorado and Hondo Rivers, two of the eastern tributaries of the Magdalena system. The "Arroyo Hondo," as it is locally known, passes through the main sierra between the northern peak of the Cerro Bobali and the southern end of the Sierra Motilone. This is an instance of river capture, the stream now having its source in a basin on the eastern side of the mountain range. The eastern and northeastern edges of this basin are of a height ranging about 5,000 feet to 6,500 feet. Through a gap of the lower elevation—named "Bolan Pass"—we located a route for the construction of a transportation system which when completed will permit the petroleum of the Barco Concession to be transported to the Rio Magdalena.

Our next work was to construct a mule trail connecting the point known locally as Pesqueria on Lake Zapatosa with the pass. During the construction of this trail, which passes slightly southwest of the village of Curumani and on up the Rio Animito, I had occasion to make a full exploration of the Animito. At a point seven miles south of Curumani the river forks into eastern and western branches. The eastern branch finds its source in the Sierra Motilone; the western branch is formed by the union of three streams—two of which are named by local hunters the "Rio Horno" and the "Quebrada de Casa Piedra" (Ravine of the Stone House). The name of the latter is derived from the fact that at a sharp bend of this stream a huge cavern 100 feet long, 30 feet wide, and 8 feet high has been carved out of solid rock by the downrushing floods.

Expedition Down the Rio de Oro Planned

About this latitude (10° N.–7° N.) the Sierra has two well-marked rainy seasons. On the western side the rainy seasons are from mid-April to mid-May and from mid-September to mid-November; on the eastern side they are somewhat later. In the latter part of October every day there was a heavy downpour of rain continuing on an average 14 out of the 24 hours. This circumstance rendered any further construction impossible, and it was decided that I should proceed ahead with a picked party of men over the sierras and down into the valley which we had observed from the Cerro Bobali lying on the eastern side of Bolan Pass. This valley we hoped would be found to contain one of the sources of the Rio de Oro.

Up to this point, the summit of the mountain range, we had encountered no signs of the Motilone Indians; but the peons of my party could not easily overcome their dread of the savages, who are reputed to shoot, with

great precision, arrows four or five feet in length tipped with deadly poison. At first it appeared as if we should not be able to secure peons; but skillful argument and the promise of double pay eventually secured twelve men, ten Colombians and two Venezuelans. They were well armed and carried ten days' provisions, the maximum that could be carried under the circumstances. Dogs were also taken with us to assist in preventing a surprise attack by the Indians.

Crossing the Divide

On October 24, 1920, we left Campamento La Mesa de Bolívar, elevation 4,260 feet, where for a day or two we had been organizing our expedition, and proceeded up over the Sierra Motilone, crossing the summit at 6,400 feet where a temperature of 58° F. was recorded. We now passed into the cloud zone, and progress became very slow on account of the change in the vegetation to what is known by the natives as *loma*. This vegetation grows to an average height of 20 feet and consists of thickly tangled vines and moss, dripping with moisture. It is found enveloping all peaks in this vicinity from an elevation of 5,500 feet and upwards. It took us until October 28 to cut a passage over the summit and down to a small stream which fortunately proved to be one of the sources of the southern branch of the Rio de Oro. It was a mountain torrent with strong current and a cross-section area of approximately 20 square feet. We gained it at an elevation of 3,400 feet and there established our second camp, five miles northeast of Bolan Pass. Here the terrain was covered with dense forest quite plentifully stocked with such small game as gray monkeys and wild turkeys.

Upper Course of the Rio de Oro

Below an elevation of 1,500 feet we met with an insect quite common to these regions. It is known locally as the *jejan* and is a type of small fly, very persistent and annoying. Until we reached elevations under 1,000 feet the number of mosquitoes were surprisingly few, and at night there were practically none at all, as it becomes quite cool after sundown.

Rain fell throughout the nights of the journey and for a great part of the days, falling possibly on the average more than 12 out of every 24 hours. Numerous small creeks joined the branch of the Rio de Oro down which we were progressing, and at the point reached on October 30 it had become a fair-sized river. On this date at an elevation of 1,800 feet we passed a more considerable tributary coming in from the southwest. I believe it to be the stream referred to on some maps as the Rio Loro. On the following day we crossed a stretch of flat land covered with heavy jungle in which were found signs of tapir, deer, and wild pig. Our dogs frightened up a troop of the latter, and they charged our party while we were proceeding along in single file. It is a well-known fact that these animals once started in a certain direction will not deviate from their course but will attack with

their tusks every living thing in their path. The only thing to do when one finds oneself in line with such a charge is to step behind a tree and endeavor to attract as little attention as possible. On this occasion we shot one of the pigs, which are considered excellent meat by the peons. On the afternoon of this date while wading along down the river, which now was of considerable size, we had what proved to be our last view of the point in the sierras where we had crossed. It was 24 miles away from the spot where we were and 78 degrees west of south.

That night we camped a short distance up on the slope of a small sierra near the river. Rain fell continuously and heavily all night, and in the morning the river had risen so much that it was impossible to wade along the stream bed. We therefore took to the high ground and were greatly surprised to find an old trail, evidently constructed with considerable labor. It consisted of a path about three feet wide, excavated at some former time and laid along very gradual grades. It was the continuation of the cattle trail from Tamalameque to Cúcuta. The only existing maps show this trail after crossing over the Cerro Bobali as turning to the southwest and passing onward to Cúcuta; but we found, on the contrary that after dropping down to the Rio de Oro the trail follows the eastern and southern banks of the stream until it comes to the point where we encountered it, about 30 miles to the northeast of Cerro Bobali. We followed it where convenient for 30 miles more, but as it was quite overgrown with jungle much cutting was necessitated.

The Northern Branch of the Rio de Oro

At midday of November 3 and at a distance of 43 miles from the crest of the sierras we reached the northern branch of the Rio de Oro. This is a stream of somewhat larger size than the one along which we were traveling. Its source is, I believe, in a deep depression which I had noticed on the eastern side of the Sierra Motilone many miles to the north of our crossing point, I should say almost directly opposite Curumani. Near the junction of the two branches of the Oro the terrain consists of flat land, heavily jungled, while scattered over the surface are isolated boulders of hard rock.

Abandoned Fishing Camps

The following day we passed some abandoned Indian fishing camps a short distance above the junction of the Rio Tomas with the Rio de Oro. The Rio Tomas which enters from the south is, if anything, slightly larger than the Oro. Both rivers were here of great depth and strength of current. Here we found our first crocodiles, the presence of which made it impracticable to ford by swimming. After a short search we found some *balsa* trees, so known because of the very buoyant character of the wood which permits the tree to float readily even when still green.[5] With these we

[5] An interesting note on the occurrence of *balsa* wood is given by W. W. Rowlee: Synopsis of the Genus *Ochroma*, with Descriptions of New Species, *Journ. Washington Acad. of Sci.*, Vol. 9, 1919, pp. 157–168.

constructed a raft of sufficient size to carry in three trips our entire party across the river.

We continued for the next few days pressing forward along the eastern bank of the river, which although very crooked and erratic in its course, maintained a general direction to the north. At noon on November 6 we passed the mouth of a tributary stream possibly 70 feet in width, entering from the east. Hereabouts the valley was wide, and there appeared to be much open country. At this point we left the Tamalameque-Cúcuta cattle trail which turned to the east towards Cúcuta. Near here we shot two large female monkeys, which furnished much-needed food, as we had been without provisions for two days.

Fig. 3—Arrows and spears taken from Motilone Indians on the Rio de Oro. (Photograph by courtesy of the Carib Syndicate.)

Slow and Arduous Travel

From now onward our journey was a monotonous story of slow and arduous travel through heavy jungle and up and down the rock cliffs that bordered the river with little intermission. We passed through country broken by an endless succession of *quebradas* which, because of the frequent change in direction of the main stream, seemed to be running in all directions. We were compelled to follow the river closely, attempts to seek a shorter route being restrained by the fear of losing the river altogether once it should be out of sight or hearing. Nor were our attempts to descend by raft any more successful—we were immediately wrecked in the rapids.

One day (November 20), while a short distance away from and above the river and climbing a 2,000-foot hill, we encountered the first signs of any previous human presence that we had observed since we passed the abandoned fishing camp at the junction of the Rio Tomas. Following the ridge of this mountain we found a few machete cuts which had evidently been made by Indians. This trail we followed with much trouble, as it was very faint. Later we came down to the river again where we found an Indian raft secured on the opposite shore and constructed of two *balsa* logs tied together with *bejucos*, a vine that serves the native as a rope.

Our situation was becoming increasingly precarious. Our limited pro-

visions had been consumed. We shot one or two monkeys and a couple of wild turkeys. These with a few fish were the last game that we secured on the journey. The men were sick with fever and exhausted from lack of food. On the 29th day of the expedition we killed and ate one of the six famished dogs remaining with us, and two more on the next day.

Signs of the Motilones

At this time becoming desperate at the slowness of our travel I decided to strike back a short distance from the river into the highlands and attempt to cut off some distance round the bends. Shortly after taking this course we encountered an Indian trail which for a time proceeded in the direction desired, or practically due east. We went forward quite easily along it for possibly a mile and half but then began to fear that we were going to lose the river, without which I had no hope of ever arriving at a point in the Maracaibo basin. I decided to leave the trail and bear off to the left in an attempt to get in touch with it once more. In passing along the trail we saw four empty houses of the Motilones, two of which had evidently just been constructed, as the palms and *bejucos* which formed them had been freshly cut. Within, however, there was absolutely nothing—neither occupants nor food nor equipment. The huts were of the same type of construction as that in Figure 4.

An Important Indian Trail

While searching below we also came across a well-beaten trail, about four feet in width, following natural easy grades along through the hills and evidently much used. I believe that this is the main trail connecting the divisions of the Motilone tribes separated by the Rio de Oro. We turned and followed this trail to the river. On our way we found fresh skins of plantains, evidently dropped by the Indians, and, on again reaching the river, an Indian *balsa* raft tied up to the bank. A little later we heard a slight noise below and found that a party of five Motilone Indians had come down from the same direction that we had followed and were preparing to embark on the raft. All were well armed with bows and arrows and one with a steel machete. Three of the Indians carried packs on their backs, evidently containing plantains. Apparently they had not noticed the passage of our party down the trail. The peons who had followed me were barefooted and had undoubtedly obliterated my boot prints. The Indians used two long poles to propel their crude raft across the river and, after securing it on the opposite shore, passed into the forest and disappeared.

Building a Raft

At the close of that day (November 22) about a hundred yards from the point where our camp site was pitched we discovered, much to our surprise, nine *balsa* trees with an average diameter of about twelve inches. The

existence of these trees at this point was surprising. For the past fifteen miles we had looked carefully for trees of this type and could find none and had decided that we had passed the limits within which they grow. Early next morning I assembled such of the men as were fit to work for the construction of a raft. Of the twelve there were only four who could stand on their feet and effectively use our one axe and machetes. The remaining eight lay around the fire and groaned or talked about the "end" which they believed was very near. These natives possess very little spirit and in danger or during privation are anything but cheerful companions. The

Fig. 4—Motilone hut near the Rio de Oro. (Photograph by courtesy of the Carib Syndicate.)

nine trees we felled were dragged to the river and fitted together with three cross pieces secured very firmly at the joints with *bejucos*. About midday we had built a very strong raft.

Last Stages of the Journey

It was necessary for us to get away from that spot with speed, as the guards I had posted on the cliffs above the river reported fresh signs of Motilone Indians; and I believe had we remained we should have been unpleasantly reminded of their presence before the day was over. We placed all of our equipment and the one remaining dog aboard the raft and started about one o'clock. About a half mile below the point where we embarked we encountered strong rapids. Several times the raft went aground on boulders, but by jumping into the water we managed to get it clear of these obstructions. After passing this point we did not find any other dangerous rapids, though there were many places where the river became narrow and swept around sharp bends. We proceeded along at a rate of six miles an hour with but little trouble.

Two miles below where we launched the raft we entered an entirely different region. The country on either side was that commonly known as the *llanos*, here densely forested. Hills had almost entirely disappeared. A few wild turkeys and other small game were observed in the forests on either side. About two o'clock, and at a distance of 125 miles from the point where we first reached the source of the Rio de Oro, we passed the junction of the Rio Motilone. The Rio Motilone at the point where it joins the Rio de Oro is about 300 feet in width at this period of high water and is but slightly smaller than the Rio de Oro.[6]

FIG. 5—Jungle on the banks of the Rio de Oro near its junction with the Rio Catatumbo. (Photograph by courtesy of the Carib Syndicate.)

We continued onward for another hour and then landed and prepared a camp for the night on a small beach. Hoping that it would not rain, and much against my better judgment, I selected this as a site contrary to our usual custom. To have encamped on higher ground in this vicinity would have necessitated much clearing with machetes because of the heavy jungle all along the shore. Near this camp site we found a smaller type of plantain known as *guineos*. These were green and about four inches in length but when boiled proved to be very palatable. We gathered many and ate them at intervals throughout the night, as it was the first food we had had for many days. At midnight the rain, which had ceased for about eighteen hours, began once more, and the river gradually rose and finally covered the *playa*, or beach. Rainfall continued until daybreak, and the first light found us standing in water to our waists and endeavoring to keep hold of the raft upon which depended our salvation. Shortly after daybreak the downpour ceased, and the river began to subside until at 9:30 it had receded

[6] An exploration of the Rio Motilone to its source has been made by Mr. A. Faison Dixon, in a geological reconnaissance from the Colon oil area.

so much that I deemed it safe to embark, although the current was still bringing many fallen trees and wreckage from upstream.

Now, as well as during the latter part of the previous day, the river swung from an easterly direction to south and southwest and even at times westerly, describing a series of great loops. At one time we probably were only a few miles distant from the point where six days before we had been toiling laboriously on foot.

Arrival at the Oil Wells

On November 24, the 32nd day of the expedition, and at a distance of 156 miles from where we had found the source of the Rio de Oro, suddenly rounding a bend in the river we came in sight of an island covered with cultivated plantains. We next saw a cluster of buildings which one of the peons who had formerly been employed at the wells recognized as the camp of the Colombian Petroleum Company, our objective. As we came into view of the camp the peons, who had asked my permission in the early days of the expedition, began firing their rifles and revolvers in the joy of once more seeing signs of civilization and the hope of soon securing food. When the noise of this fusillade reached the camp the employees of the petroleum company at once rushed for their rifles, believing that they were attacked—not by the Motilone Indians, who have no firearms, but by a force of revolutionists—and it was only when they saw our men discharging their firearms in the air that they knew that we were friends.

We spent two days at the petroleum camp, during which time we fitted ourselves out with much-needed clothing from the company's commissary and ate a meal nearly every two hours of the forty-eight. The effect of our hunger was so nerve-racking that it was impossible to sleep except for a few minutes at a time.

Departure for Maracaibo

At 2 o'clock on the morning of November 27 the management turned over to my use a canoe and two giant Venezuelans for canoemen. We left quietly to attract as little notice as possible, inasmuch as many parties had been attacked by Indians on the Rio de Oro in the twelve-mile stretch between the petroleum camp and the junction with the Catatumbo.

The country we passed through was *llanos*—great stretches of fairly level land hereabouts covered by gigantic forests of *ceiba*, a soft-wood tree, and *caracoli* and many other hard-wood trees. On the beaches were large numbers of crocodiles, for this was the season in which they lay their eggs along the shores. For this reason it was also a dangerous time to travel on the river, as the Indians hunt these eggs for food. The forests abounded with game. I saw three different kinds of monkeys, deer, tapir, and several species of wild turkey. It was not until we had traveled 90 miles that we saw the first signs of human existence after leaving the petroleum wells.

At 9:30 P. M. the outlines of Encontrados showed ahead of us, and shortly afterwards we pulled up to the docks among some sail and gasoline boats. With the aid of the current my two peons had paddled me a distance of 105 miles in 19½ hours. Encontrados is a town of 2,000 population. In the day time it has a sizzling, humid temperature, which at times reaches 110°. It lies at the southern terminal of the steamer route which connects northerly with Maracaibo. It is also the northern terminal of a short railroad, the Gran Ferrocarril del Táchira, which connects Encontrados with a point in the south called Estación Táchira, a few miles across the international boundary from Cúcuta, Colombia. From Encontrados I secured passage on the biweekly river boat which plies between the town and Maracaibo.

Result of the Journey

I believe that this journey is the only passage made across the great block of territory lying between the Rio Magdalena on the west and Lake Maracaibo on the east and between the latitudes of 10° 30′ N., the approximate location of the disused trail across the Sierra Perijá, and 8° 30′ N., the location of the abandoned cattle trail from Tamalameque-Cúcuta. It is the only exploration made of the Rio de Oro between one of its sources and its junction with the Catatumbo. Its result has been to place on the map 168 miles of river where heretofore some dozen leagues of fanciful watercourse were shown.

THE RATON MESAS OF NEW MEXICO AND COLORADO*

By Willis T. Lee
U. S. Geological Survey

The Raton mesas, or table-lands, are situated east of the Rocky Mountains in southern Colorado and northern New Mexico. They occupy a belt 25 miles or more in width extending from the town of Raton, N. Mex., which is situated about forty-five miles east of the foothills proper, eastward into Oklahoma a distance of nearly 100 miles. They differ greatly in size. Some rise only a few feet above the general level of the plain on which they rest, others more than 3,000 feet above this plain.[1]

There is difference of opinion as to the name appropriate for this group of mesas. A few writers have used the name "Mesa de Maya" as a collective term after the largest of the group. Others use the term "Raton Mesas," adopted from the loftiest and best known of the group. The latter conforms to local usage, and "Raton Mesas" is the term used generally in the thickly populated region near the western end of the group, whereas few people have ever seen Mesa de Maya. The term "Raton Mesas" is also used by the U. S. Geological Survey, which now employs the term "Raton Mesa region."

The word "mesa," meaning table, is used in the southwestern part of the United States almost exclusively in place of table-land, and most of the mesas would be called table-lands or plateaus in other parts of America. However, the term is applied rather loosely; and in many instances terraces, benches, and other types of land form are called mesas.

The Raton mesas are all true table-lands, having flat tops and precipitous slopes on all sides. The surface from which they rise is a part of the Great Plains, which at the western end of the mesa region is about a mile above sea level. This surface falls gently away from the mesas to the south, east, and north; and the streams rising in these highlands radiate from them in these three directions, winding over the mile-high plain for considerable distances before dropping into the narrow canyons, some of which are more than 1,000 feet deep.

There are three major surface levels, which give the mesa region the form of a broad complex pyramid: a lowland plain south of the 1,000-foot Canadian escarpment, which extends from a point south of Las Vegas northeastward past Clayton, N. Mex.; an upland plain between this scarp

* Published by permission of the Director of the United States Geological Survey.

[1] This article deals with the physiography of an interesting region the human aspects of which were touched on in the article by Charles R. Keyes: The Hanging Gardens of the Mesa de Maya, *Geogr. Rev.*, Vol. 8, 1919, pp. 145–152.

corresponding to the Canadian escarpment and the mesas; and the high table-lands, or Raton mesas, which culminate in Fisher's Peak. Toward the east and north there is no intermediate scarp corresponding to the Canadian escarpment, and the plain slopes gradually from the foot of the mesa scarp to the level of the Arkansas River, whose valley in relations corresponds in a general way to the broad Canadian valley south of the great scarp.

The mesas are remnants of erosion, parts that were not worn down to the general level of the Great Plains. Their shape results from the character of the rock composing them. Each mesa has a table top, or cap rock, of hard basalt which was poured out from numerous volcanic vents as molten lava at a time when the general surface of southern Colorado and northern New Mexico was relatively much higher than now. Under the lava cap are comparatively soft shale (Cretaceous) and coal-bearing shale and sandstone (chiefly Tertiary). Because these easily eroded rocks are protected by sheets of hard cap rock, the mesas maintain steep sides as they are slowly eroded away.

The larger mesas rise to altitudes ranging from 7,500 to 9,500 feet above sea level, or 1,000 to 3,000 feet above the surface of the plains. In consequence of the altitude rain falls on the mesas while the lower plain around remains parched and dry. It is no uncommon circumstance for a mesa top to be shrouded in cloud for considerable periods and kept moist as if drenched with heavy dew. During my survey work on Johnson Mesa a rainy night was followed by foggy weather and a slow drizzle of rain. No outdoor work could be done, and towards noon we started for Raton. On reaching a point a few hundred feet below the rim of the mesa we passed below the fog or cloud and about two miles from the rim encountered bright sunshine. But the top of the mesa remained shrouded in cloud most of the day.

But while the mesas are high enough for frequent summer showers they are also high enough for disastrous frosts in late spring and early fall and for heavy winter snows.

Some one has said that mesas are inverted oases. If an oasis is a "hole in the ground," as Mark Jefferson has said, a mesa may be termed a "hole in the sky." The Raton mesas are productive areas in the desert realm of cloud, for they are not so high as to be barren on account of the cold. Some of them are used for grazing, others for tillage. As grazing areas they have both advantages and disadvantages. There are practically no trees on the mesa tops, although the sides are well forested except where the slopes have been stripped for lumber or firewood. Grass grows luxuriantly, but if the cattle are not brought down before snow falls many of them die from exposure and from accident on the steep slippery trails. Another drawback to the mesas as pasture lands lies in the electric storms, for many an animal is killed there by lightning. During our work on the mesas, where we traveled chiefly on horseback, we soon learned to dismount and seek low ground at the first flash of lightning.

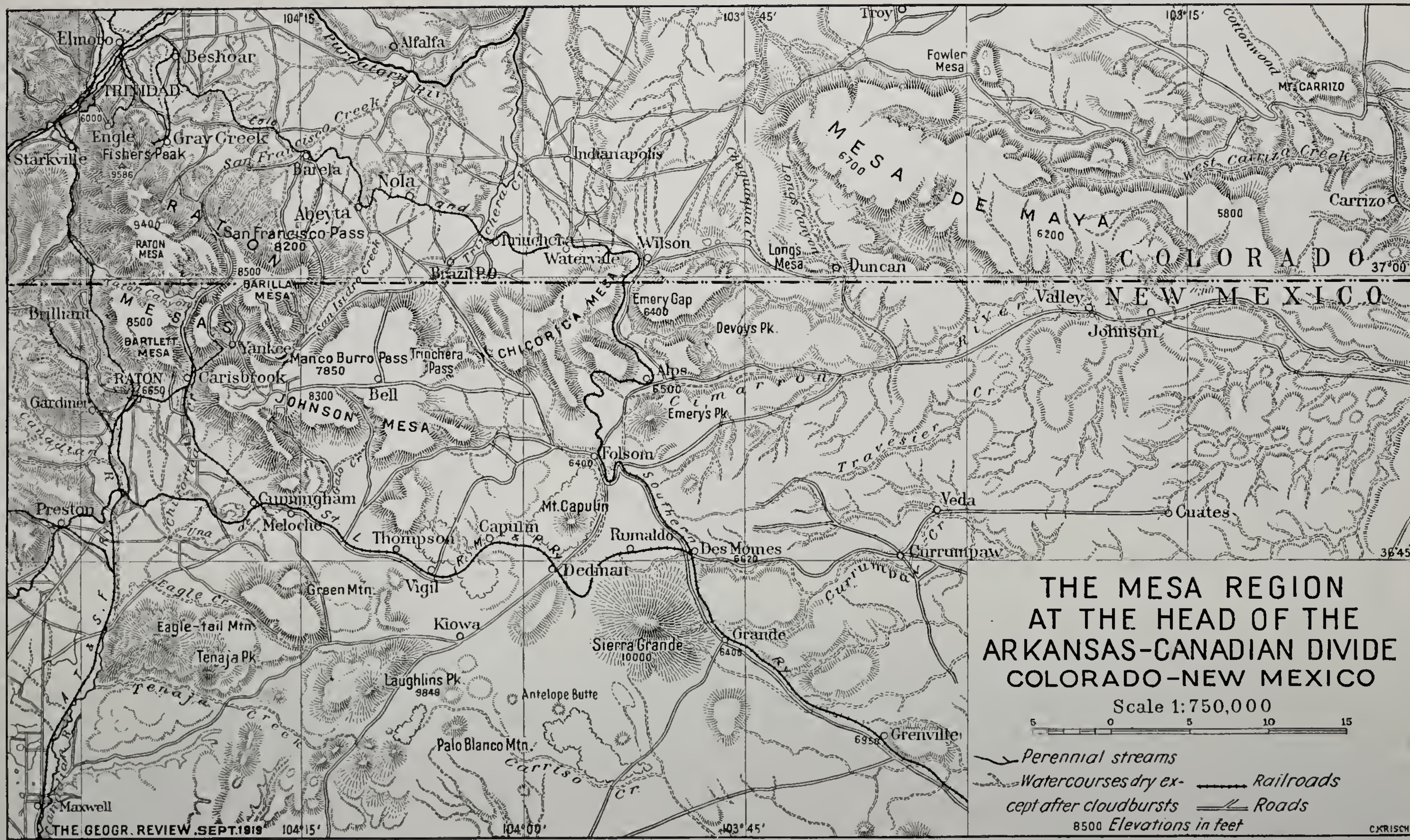

FIG. 1—Map of the Raton Mesa region. The term Raton Mesas is used both in a restricted sense, as on the map, and in a collective sense for the entire region. The latter is the usage of the U. S. Geological Survey (see U. S. Geol. Survey Prof. Paper 101, 1917). The sources upon which the map is based are of unequal value: only a third of the area is covered by topographic sheets of the U. S. Geological Survey. For detailed note on sources see footnote on p. 145, *Geographical Review*, Vol. 8, 1919.

Johnson Mesa is the one most extensively used for agriculture, and thousands of acres of its surface are under cultivation. The rich black soil derived from the disintegration of basalt produces good crops of hay and grain and such other products as can withstand the rigors of the climate. But the communities, although within sight of the through lines of traffic, are really far from them, and the traveling public knows little of these dwellers among the clouds. From their lofty stations the mesa men gaze unobserved over broad fields of activity. The Colorado and Southern Railway, which connects Denver with the Gulf of Mexico, skirts the mesas on the north and east; and the Santa Fe Railway, one of the chief transcontinental thoroughfares, on the west and south.

The mesas owe their existence to volcanic activity. Ages ago molten basalt flooded the surface and hardened into resistant layers. Where the soft older rock was not covered with lava it was worn down by rain and stream, and a lower plain was formed. The lava outpoured on this lower plain, and again the surrounding country was eroded away. This process continued and resulted in a number of lava-covered benches such as those shown in Figure 5, page 390. There are three well-marked and conspicuous benches and several less extensive ones. Each has its distinguishing characteristics, chiefly volcanic. Hence a study of the mesas is largely a study of a great but little-known volcanic distiict.

Features of the Mesa Region Observed from the Santa Fe Railway

Travelers over the Santa Fe route pass through Trinidad, Colo. Those interested in natural objects will notice a conspicuous height of land which rises about 3,600 feet above this station. It is called Fisher's Peak, although in reality it is not a peak, properly speaking, but only the projecting point of Raton mesa, the peaklike appearance being due to perspective. The main part of the high table-land of Raton Mesa is beyond the point and cannot be seen. The blocklike appearance of the top of Fisher's Peak is due to the lava cap, about 600 feet thick, which consists of several sheets of basalt. This cap of hard rock rests on soft, easily eroded sandstone and shale containing the beds of coal that make the Raton Mesa region one of the most important coal-mining centers in western America.

On leaving Trinidad the westbound train with two extra engines as helpers toils laboriously up the steep, winding grade to Raton Pass—a climb so difficult that in order to divert heavy traffic from it a new Santa Fe line was constructed across half of New Mexico and parts of Oklahoma and Texas.

For many miles Fisher's Peak is the most conspicuous object of the landscape. At its base lies Starkville, the first coal-mining town passed on the route. The coal is taken from under Fisher's Peak, and the mine workings extend through the northern part of the mesa and emerge on the

opposite side. Three other coal-mining towns are passed on the way to the crest, where the traveler crosses the state line into New Mexico and plunges almost immediately into a tunnel which penetrates the highest ridge of the pass. The last mine before the tunnel is reached is named for Dick Wootton, an early scout, Indian fighter, and associate of Kit Carson. At a time long before the railroad was built, when this part of the country was full of hostile Indians and still more hostile "bad men,"

Fig. 2—Fisher's Peak as seen from a point near Trinidad, Colo. The "peak" rising 3,600 feet above the town is the point of Raton Mesa whose flat top is maintained by sheets of hard basaltic lava.

Wootton constructed a toll road over Raton Pass and at his headquarters collected toll from those whom he could persuade to pay. Be it said, however, that he reached opulence and a ripe old age, in part by virtue of not seeing and hearing things which did not immediately concern him, and in part by his well-known ability to defend his interests against all comers. From the tunnel southward the road skirts Bartlett Mesa and at the town of Raton is again on the plain which was left at Trinidad.

From points south of Raton a variety of interesting natural features may be observed. To the east Johnson Mesa rises boldly from the plain. Farther south is a large group of volcanic mountains. Mt. Laughlin may be recognized by its smooth oval form, Mt. Tenaja by its square flat head, and Eagletail by its dark-colored pointed summit. Eagletail is an old volcano. A broad cone with gently sloping sides was built long ago by molten igneous rock. Then followed a long period during which the mountain was eroded.

In relatively recent time volcanism was renewed, and a steep-sided cinder cone was formed at one side of the old crater. This cone is covered with piñon pines, which make it dark-colored and give it the appearance of being distinct from the older parts of the mountain which are devoid of trees. To the right of our route are the precipitous bluffs of coal-bearing rocks. In the sheltered nooks at the foot of the bluffs formed by streams which have cut numerous canyons in the highlands nestle the mining towns of the Raton coal field. Here is produced much of the coke used in the smelters of the Southwest.

Bartlett and Johnson Mesas

Turning attention again to the mesas proper, the one nearest to Raton is Bartlett Mesa, whose nearly flat top, six miles long and four miles wide, is about 2,000 feet above the town. The cap rock consists of columnar basalt and terminates in steep cliffs which can be scaled in few places. Near the northern rim is a volcanic cone which marks the vent through which the basaltic lava of the cap rock was extruded.

Directly east of Raton at a distance of six miles is the western end of Johnson Mesa. The main part of the mesa lies farther to the east and has not yet been mapped with the same degree of accuracy as the western end. Like Bartlett Mesa it is lava-covered and rises to a general altitude of about 8,500 feet above the sea. From this general level, however, peaks of igneous rock rise to still greater heights. Towndrow Peak, a beautifully conical mountain of pink andesite, rises about 300 feet above the general level of the mesa. A few miles east of this peak is a recently formed cinder cone, and still farther east are several other peaks of volcanic rock.

The basalt of Johnson Mesa is columnar in many places, and the rim is generally so precipitous that the expense of constructing roads and even trails is heavy. The sheets of lava are horizontal, like those shown in Figure 5, but in some places along the precipitous rim the ends of congealed lava streams are exposed where they have been truncated by erosion, showing columns radiating from the center which indicate progressive cooling from circumference towards center. Looking northward from the rim the observer obtains a beautiful view of the steplike structure of the mesas caused by alternate erosion and extrusion of lavas. Figure 6 shows two of these mesa levels.

Features of the Mesa Region Observed from the Colorado and Southern Railway

Some of the most interesting views of the mesas are to be obtained from the Colorado and Southern Railway between Trinidad, Colo., and Des Moines, N. Mex. This road skirts the high mesas for a distance of 80 miles. On leaving Trinidad the southbound traveler goes in a general south-

FIG. 3

FIG. 4

FIG. 5

FIG. 3—Johnson Mesa as seen from Raton, N. Mex.—a lava-covered table-land rising 2,500 feet above the plain on which it rests.

FIG. 4—Towndrow Peak, a conical mass of pink andesite rising 300 feet above the top of Johnson Mesa.

FIG. 5—The rim of Barilla Mesa as seen from Johnson Mesa. The cap rock is made up of several sheets of basalt.

Fig. 6

Fig. 7

Fig. 8

Fig. 6—Parts of Bartlett Mesa in foreground and the higher older Raton Mesa in the background. Raton Mesa was partly eroded away before extrusion of the lava which now caps the younger and lower mesa.

Fig. 7—Mt. Capulin, N. Mex., a crater cone of recent origin consisting of cinders and flow lava. It is about 8,200 feet in altitude and rises 1,300 feet above the plain on which it rests.

Fig. 8—View of Baby Capulin, a very young cinder cone near Folsom, N. Mex.

easterly direction along the base of Raton Mesa, then of Barilla Mesa, and finally turns southward around the eastern end of Chicorica Mesa through Emery's Pass, which has been famed for rough going ever since the early pioneers found difficulty in urging their ox teams over this rough stretch of the old Santa Fe trail.

At this pass the traveler leaves the great Mesa de Maya on his left and winds about the eastern end of Chicorica Mesa, avoiding the rugged slopes on his right and the deep tributary gorges of the Canyon of the Dry Cimarron on his left; doubles back to the west around the head of this canyon; and finally emerges from the hills into one of the most remarkable volcanic districts in America, filled with crater cones and lava flows and a variety of minor land forms characteristic of a volcanic region.

Mt. Capulin, a Recent Crater-Cone

Mt. Capulin is the most conspicuous object in this district. It is a truncated cone of recent origin, composed partly of flow lava and partly of volcanic cinders. This cone rises 1,300 feet above a platform of flow lava whose surface lies at an altitude about 6,700 feet above sea level. In the summit is a cup-shaped depression, or crater, about a quarter of a mile across, inclined toward the west so that the eastern part of the rim is 300 feet or more higher than the western part. The crater marks the vent through which the lava of the cone reached the surface. In this respect Capulin differs from some of the conical mountains of igneous rock in this district, which show no evidence that they ever had a crater. To distinguish it and other cones of like character from conical mountains formed in other ways, the term "crater-cone" is here used to designate a cone built up around a volcanic vent by lava which reached the surface through that vent either in a molten state or in fragmental condition. As Capulin has a well-defined crater and was built partly of molten lava and partly of cinders extruded from that crater, it may be regarded as the type of a crater-cone. This splendid product of volcanism has been reserved by the United States Government as a national monument.

Many voluminous floods of lava were extruded from this great vent. One made its way down the Canyon of the Dry Cimarron for a distance of about 27 miles. Others spread out in broad sheets covering large parts of the plain. Some of these flows are so recent that little soil has accumulated on them. Caves formed by the flow of molten lava from beneath the hardening crust are numerous, and there are many domelike "blister cones" where the cooling crust buckled before the flowing mass became stationary.

From the top of Capulin a remarkable panorama opens to view. Lava flows and crater-cones, some composed of cinders and others of flow lava, appear as far as the eye can reach. Toward Folsom one gazes downward directly into the throat of two small cinder cones called Little Capulin and Baby Capulin. The latter consists of a circular rim of cinders about 200

Fig. 9

Fig. 10

Fig. 9—A "blister cone" at the foot of Mt. Capulin formed by the buckling of the crust of partly cooled lava.

Fig. 10—View of lava field northeast of Mt. Capulin and of a very young volcanic vent as seen from the top of the great cone.

Fig. 11—Sierra Grande, an old, deeply eroded volcanic cone near Des Moines, N. Mex. The photograph well illustrates the approach of the characteristic violent storm

Fig. 12

Fig. 13

Fig. 12—Mt. Robinson, a crater cone near Mt. Capulin, intermediate in age between the younger cones of the Capulin group and the old cones represented by Sierra Grande.

Fig. 13—Three generations of flow lava shown in the Canyon of the Dry Cimarron east of Folsom, N. Mex. An ancient lava flow from Mt. Emery, which is situated on the highest bench shown, entered the canyon and was partly eroded away before a recent flow covered the floor of the canyon.

feet high with a cup-shaped crater reaching down nearly to the level of the surrounding plain.

Close to the foot of Mount Capulin is a young vent which may be called an embryo volcano. To one looking directly downward from the top of Capulin this vent has the appearance of a horseshoe. On the ground it appears as a genuine crater nearly circular in outline and 200 feet in diameter. The rim consists of flow lava about 10 feet high and 20 feet wide, broken away for a space of 50 feet where the molten lava left the crater. It is doubtful if more than one flow of lava was extruded from this vent. It might be called a one-eruption crater.

It is not known when these craters were formed, but their fresh appearance indicates recent origin. It can safely be said that some score or more of the cones were formed when the general surface of the district was more than a mile above sea level. The one on Bartlett Mesa and that described from Johnson Mesa (Fig. 6) rest on surfaces about 8,500 feet above the sea. These lava flows and crater-cones should be a sufficient refutation of the statement, still frequently repeated, that volcanoes form only near the seashore.

Sierra Grande, an Old Crater-Cone

Des Moines, N. Mex., where the Raton branch of the Santa Fe Railway joins the Colorado and Southern, lies at the base of Sierra Grande, a very old crater-cone and one which differs notably in shape from the younger cones of this district. Apparently it was formed by the extrusion of fluid, freely flowing lava, which built up a cone of broad base and gently sloping sides. This cone is so old that the crater has been almost wholly destroyed. Its position is marked by a hollow in the side of the peak and by the presence at the summit of red scoriaceous lava filling the old conduit which was once the throat of the volcano.

The altitude of Sierra Grande is known only approximately. According to aneroid reading it is nearly 8,500 feet, or about 2,500 feet higher than the plain on which it rests.

The clouds shown in the illustration of Sierra Grande may be worth passing mention. The mesa country is visited frequently by the short violent showers of rain and hail commonly known as "cloud-bursts." These cloud-bursts are often locally disastrous. It is not uncommon for every green thing to be destroyed by hail within a narrow belt sometimes less than a mile wide, while no damage is done on either side.

Crater-Cones of Intermediate Age

Near the very recent crater-cones of the Mt. Capulin group are several older craters. At an escarpment just north of Capulin the surface rises abruptly from the plain on which the young cones rest to a bench in the side of the mesa several hundred feet above the lower plain. This bench is a remnant of a surface which was largely eroded away to form the lower plain

and later covered with lava. It consists of sheets of basalt overlying shale, and on it are volcanic cones now partly worn away. These belong to a group of some dozen or more relatively old crater-cones, which may be called middle-aged volcanoes, as they are intermediate in age between the younger cones represented by Capulin and the still older ones represented by Sierra Grande described above. Mt. Robinson situated west of Folsom may be selected as the type of this middle group. It consists of highly scoriaceous lava, much of it so light in weight that it would float readily on water. Any cinders which may have once accumulated about it have disappeared. The slopes are worn to smooth soil-covered surfaces. The crater as originally formed has been modified in shape until it now resembles an inclined U.

The volcanic cones about Mt. Capulin correspond in age in a general way to the stages of mesa development. The old, deeply eroded Sierra Grande is a result of the ancient volcanism which produced the lava caps of the higher mesas. Those of middle age, represented by Mt. Robinson, correspond to the mesas of intermediate height; and the lavas from Mt. Capulin, resting on the recently eroded plain and on the floor of the youngest canyons of the region, correspond in age to the last cycle of erosion.

At one point in the Canyon of the Dry Cimarron I was fortunate enough to get a photograph (Fig. 13) showing three generations of lava flows. An ancient volcanic cone called Emery's Peak stands northeast of Folsom near the rim of this canyon. Ages ago basaltic lavas extruded from it, flowed over the rim, and accumulated on the floor of the canyon. Later erosion deepened the canyon many hundreds of feet, but the old bed of lava was not entirely removed. Some of it still remains as a broad shelf in the side of the canyon. At a still later time a stream of molten lava from Capulin or from one of the neighboring craters flowed down the canyon. Remnants of this lava flow remain as the dark-colored craggy masses on the present canyon floor.

PHYSIOGRAPHIC EFFECTS OF THE VOLCANISM OF MT. ST. HELENS *

By Willard Rouse Jillson
Kentucky Geological Survey

Mt. St. Helens, lying roughly midway between Mts. Rainier and Hood, is more remote and less well-known than either of these peaks. The plateau from which it rises is minutely dissected and densely forested. Only two wagon roads, bad beyond description, approach the mountain fastness; none traverse it. The lower river bottom farms, rich though circumscribed, become gradually smaller and poorer as one approaches the headwaters. Lately fenced grass-carpeted meadows, studded with neat white-painted barns and houses, give way to bushy stump-lot clearings and single-room log cabins. These in turn becoming more infrequent stand with their backs to the virgin timberland of hill and mountain side. All through the countless inner hills and valleys, beside abandoned overgrown trails and again in the most remote and inaccessible places, are found deserted cabins, now moldering into ruins, the homes of former prospectors. Though indications of mineral wealth—gold, silver, and copper—sufficient to fascinate the novice may be found at every hand, the miserable failure of the region generally to respond to diligent search and commercial exploitation is only too apparent. The great forests of Douglas fir and kindred evergreens, now largely protected within the Federal Columbian Forest Reserve, stand as the greatest natural resource of economic importance. But to the state and the nation the region finds its first value as a paradise for the tourist and nature lover.

Configuration and Lines of Ascent

From an altitude at the base of about 4,500 feet the snow-capped summit of Mt. St. Helens rises to an altitude of 9,761 feet above mean sea level (see Fig. 1). The shape of the mountain is that of a symmetrical cone with crestal angles figured from the crest for the highest and last mile as follows: (1) to the southwest in the direction of Butte Camp, 31½°; (2) to the northwest in the direction of Toutle River canyon, 27½°; (3) to the northeast in the direction of the headwaters of Smith's Creek, 23°; (4) to the southeast in the direction of the headwaters of Muddy River, 27°. Notwithstanding the fact that the angle of inclination from Butte Camp to the crest of Mt. St. Helens is, as shown above, slightly sharper, it is coincident with the trail most frequently taken by mountain-climbing tourists. The selection of this line of ascent is due principally to its accessibility. It is possible, how-

* The field work on which the data incorporated in this paper are based was done by the writer during the spring, summer, and autumn of the year 1915 while he was a member of a U. S. Geological Survey field party mapping the Mt. St. Helens quadrangle.

ever, as has been demonstrated, to climb the mountain from several angles.

The volcanism which found active expression as recently as the early part of the last century [1] has been responsible for the creation of a number

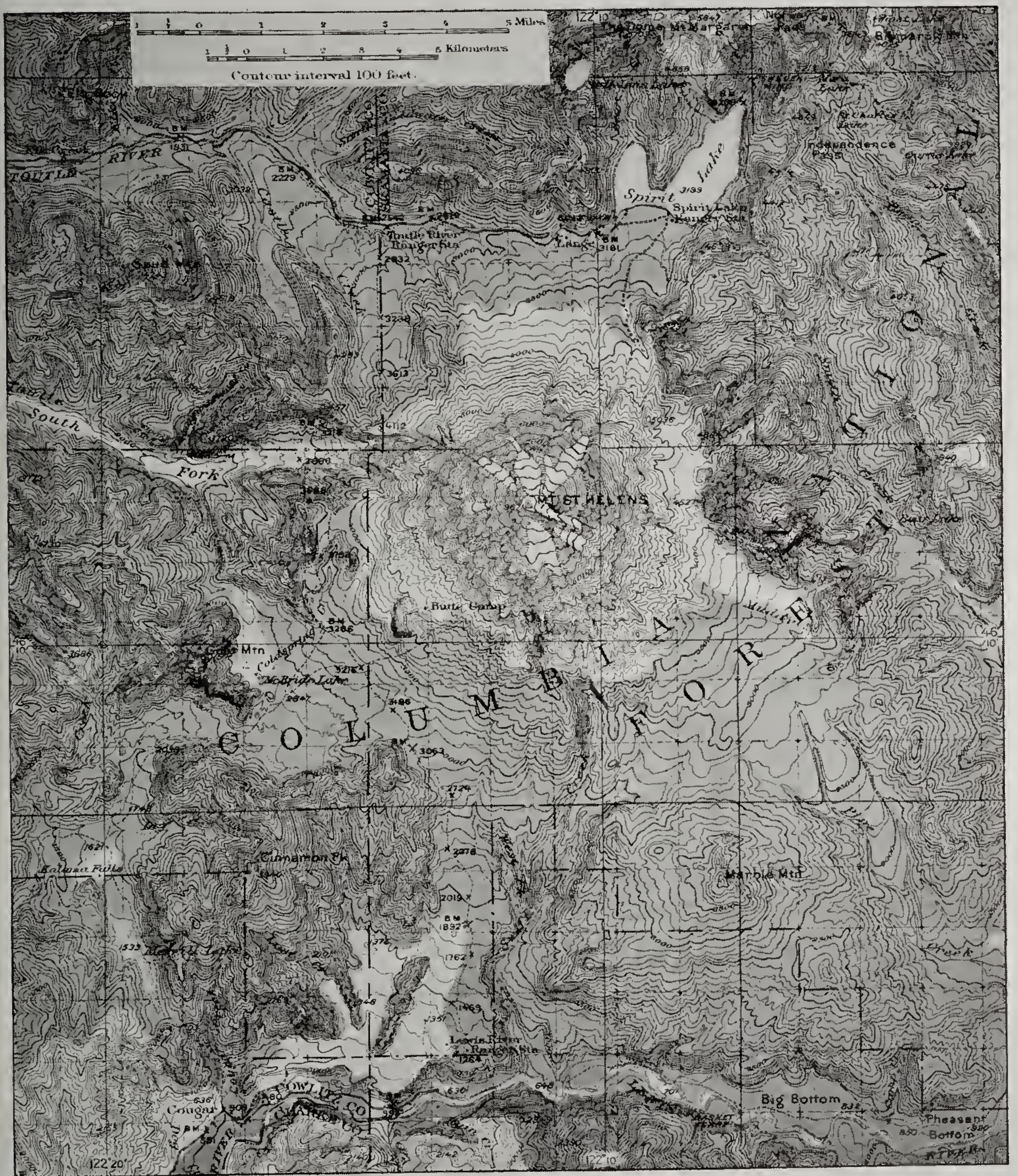

Fig. 1—Contour map of Mt. St. Helens. Scale 1:290,000. (Reproduced from the Mt. St. Helens topographic sheet, 1:125,000, of the U. S. Geological Survey, 191.)

of physiographic features which lend individuality to this old cone. Interesting as are the problems they present, these surficial peculiarities have as yet received little attention in geological and geographical literature.

[1] The Volcanic Activity of Mount St. Helens and Mount Hood in Historical Time, *Geogr. Rev.*, Vol. 3, 1917, pp. 481–485.

FIG. 2—Mt. St. Helens and Spirit Lake in early summer.

Fig. 3—Mt. St. Helens from King's Heights above Portland, Ore. The view is to the north, and the Columbia River in the middle foreground is flowing to the left. This view shows the symmetrical snow-capped appearance of Mt. St. Helens in the spring and fall.

Pyroclastic Deposits and Lake Formation

In the large amounts of pyroclastic materials and the succession of lava flows ample evidence may be noted of a rather extended period or series of periods of explosive and then quieter effusive eruptions. On the southwestern flank the headwaters of Kalama River from the vicinity of McBride Lake to below Kalama Falls have been buried under a very thick deposit of pyroclastic material, which, with other geologic agencies probably of an intrusive nature, have operated to dam up the waters of a northwestward-flowing branch of Kalama River and form Merrill Lake. This mountain pond has an elevation of 1,533 feet, is elongate in figure, and boasts two small rocky islands, uneroded ridges in the old valley. McBride Lake, located just to the east of Goat Mountain, and one or two other smaller ponds in this same vicinity were formed by the same deep deposit in which the Kalama River has cut for itself a deep, canyon-like channel.

The South Fork of Toutle River, flowing slightly to the north of west from Mt. St. Helens and fed in part by melting glacial waters, is entrenched deeply in a narrow boulder-clogged valley. There is a difference of relief of 2,500 feet from the Toutle River bed to Spud Mountain on the north and of 2,800 feet to Goat Mountain on the south. Both headwater branches of the South Fork of Toutle River head against the western slope of Mt. St. Helens proper in very precipitous canyons gouged out of fragmental débris several hundred feet deep.

Immense deposits of pyroclastics are to be found in the valley of the North Fork of Toutle River. The fill has been so general that an undulating river plain in many places over a mile in width has been developed. The river channel itself is boulder-choked and, like all of the streams heading in Mt. St. Helens, is very heavily overloaded. Great alluvial fans of fragmental materials, mostly of a very fine character, are found in the North Fork valley at the base of the mountain. Their development here has resulted again in effectually damming the headwaters of North Fork and producing the beautiful and widely known Spirit Lake. This little lake, with waters icy cold and sparkling, lies like a crystal emerald at the northern base of Mt. St. Helens. Its surface elevation is 3,199 feet, and, unlike Merrill Lake, it has a surface stream outlet.

Lava Deposits on the Eastern and Southern Slopes

On the eastern and northeastern side of Mt. St. Helens the original dendritic drainage of Smith's Creek, a southeastward-flowing tributary of Muddy River, approaches within three miles of the crest of the old volcano. The essential absence of volcanic fragmental materials and lavas on this side at elevations below 4,000 feet is conspicuous and interesting. On the southeastern and southern flanks of the mountain about the headwaters of Muddy River, Pine Creek, Swift Creek, all southward or southeastward-flowing tributaries of Lewis River, there is found the largest single expanse of volcanically modified physiography in the entire area. In this section

FIG. 4

FIG. 5

FIG. 4—View looking northward from Mt. St. Helens across Spirit Lake. Mt. Rainier is faintly seen in the far distance.

FIG. 5—Mt. St. Helens and Spirit Lake from the crest of Mt. Margaret, looking slightly west of south. The view from here shows clearly the consistent accordance of summit levels.

pyroclastics occur only in relatively insignificant quantity. This whole area, comprising between 40 and 50 square miles, is a broad southward and southeastward-sloping lava flow. The lava in many places is hundreds, perhaps thousands, of feet thick. It extends from the base of the mountain to the waters of Lewis River. At this point its rapidly increasing viscosity, induced by contact with the then swollen river, caused it to pile up several

FIG. 6—Overshadowing the surrounding hill country in height and magnificent grandeur, the snow-capped crest of Mt. St. Helens may be seen from practically every adjacent creek and valley. This view is from the Toutle River bottom land.

hundred feet in thickness in the debouchures of the former creeks and branches. The more liquid flows behind were ponded, and the crests of the former ridges were left as the only abrupt physiographic features of the immediate vicinity—rock islands in a sea of rocks. These broad and probably more or less quiet, though destructive, lava extensions distributed themselves between Marble Mountain (4,100 feet) and Cinnamon Peak (3,940 feet), which elevations are remarkable only as the highest points of the country rock presenting the original accordance of summit levels.

Topography of the Region

A careful examination of the topography, both in the field and as reproduced on the Mt. St. Helens quadrangle, reveals a region broadly uplifted

between 2,000 and 3,000 feet, with a somewhat poorly defined major axis about 20° east of north in the Mt. St. Helens vicinity. This axis will fall in line generally with Cinnamon Peak (3,940 feet); the crest of Mt. St. Helens and the lesser peaks to the immediate north; the Dome (5,703 feet); Mt. Margaret (5,847 feet); Mt. Whittier (5,818 feet); Goat Mountain (5,390 feet); Strawberry Mountain (5,732 feet); and Tumwater Mountain (5,249 feet)—the latter three of which form a portion of the southern watershed of Cowlitz River and its southern fork, Cispus River. Mt. St. Helens is located toward the southern extremity of this broad uplift, the first volcanic eruptions having broken out in the then headwaters of the South Fork of Toutle River.

Natural Phenomena of Interest to the Explorer

For the ardent explorer the Mt. St. Helens region offers many natural phenomena of interest besides the superb mountain scenery at every hand. If he goes in by the Lewis River post road with the mail he will stop at the end of a full day's travel at Cougar, which is a log cabin post office and the end of the route. Here the great southern lava flows with their old fumaroles and small gas cones are within a mile's walk. A climb of five hundred feet from the river level brings one to the top of the flow, where large areas of submerged forests are seen to have stood, the rough scoriaceous lava having filled in about them *in situ*. Where the great trees once stood the traveler will see hundreds of vertical or semi-vertical manholes in the former lava flood, now cold and partly moss-covered. If he examines closely these chilled lavas he will note that their surfaces are pitted and grooved as casts of the charred timber about which the cooling lava set into solid rock.

About a mile up the lava flow, at an elevation of 1,351 feet, occurs the lower entrance to the largest of the several lava caves of the Mt. St. Helens district. It is reported that this cave, which is really an elongate abandoned lava channel, is over a mile in length. This report, though it may be true, is not herewith authenticated. The lava cave trail will lead the mountaineer to McBride Lake or Butte Camp, if he cares to follow it, from whence he may easily make the ascent of the main elevation of Mt. St. Helens in one day, returning to Butte Camp for the night. He may then return over the Kalama River trail, passing by Kalama Falls and Merrill Lake where, if he cares to tarry, unsurpassable trout fishing may be found.

A more extended trip, and one of very great interest, takes the traveler to Lange post office on the shore of Spirit Lake north of Mt. St. Helens. The Toutle River trail, which swings to the north below Butte Camp, crosses the South Toutle River canyon at an elevation of 2,886 feet and continues almost due north to North Toutle River, whence it turns east three miles to Lange and Spirit Lake. On leaving Lange the traveler may either retrace his steps to Cougar or go out with the mail down the valley of North Toutle River to Castle Rock and Cowlitz River.

TIDE TABLES

By H. A. Marmer
U. S. Coast and Geodetic Survey

The tidal knowledge of the ancients appears to have been very meager; in fact, little mention of the tide is found in their literature. The chief maritime peoples of antiquity, living on or near the Mediterranean where the tide is small, could disregard it for practical purposes, and it likewise attracted little attention as a theoretical study. And, as with early explanations of other physical phenomena, the earlier attempts at explaining the tides were based largely on fanciful notions, such as the breathing of the earth and the power exerted by supernatural beings.

More rational theories ascribed the tide to differences in the level of the sea, to the discharge of rivers into the sea, to whirlpools and eddies, and finally to sun and moon. We have record of the fact that more than three centuries before the beginning of the Christian era the relationship between moon and tide had been noted. This relationship, however, received no rational explanation until the latter half of the seventeenth century when Newton formulated the law of gravitation and proved that the tides were one of its necessary consequences.

The ancients had little or no need for tide tables, and even until very recent times the navigator troubled himself little about accurate tidal data, for ships were operated on a schedule subject largely to the saving clause "weather and tide permitting." Now, however, an advance knowledge of the state of the tide is of great importance in maintaining an exact schedule at many places, since a change in the depth over the bar of but a few feet may mean the difference between getting a leviathan into port immediately or being compelled to wait several hours for a favorable tide.

Accurate tide tables became of prime importance during the World War; for in waiting for a favorable tide to enter port a vessel was exposed not only to possible bad weather but also to the more serious hazards of submarine attack. During the World War the importance of accurate tidal predictions was made manifest in other ways. In the case of a vessel being chased the navigator who had at hand accurate tidal data could decide whether a short cut over a shoal might be risked. During the bombardment of the Belgian coast the Allied war vessels were exposed to torpedo attack from the sea. By anchoring in the shoalest water possible considerable security was afforded, since if a torpedo was fired it was more likely to strike the shoal than the ship. That accurate tidal data were requisite for this purpose is evident from the fact that on the Belgian coast there is a range of from ten to sixteen feet in the rise and fall of the tides.

The oldest tide table of which there appears to be any record is one now

in the library of the British Museum. It is a manuscript table, apparently written in the thirteenth century, and gives the time of "flod at london brigge"—the time of high water at London Bridge. The modern navigator would scarcely recognize this as a tide table, for the times of tide are given not for calendar days of the month but only with reference to the moon's age. Of the modern tide tables the first appear to have been published by the British Admiralty in 1833. These tide tables gave the predicted times of high water only. In 1839 the French Hydrographic Service began the issue of its "Annuaire des Marées," and in 1853 the U. S. Coast and Geodetic Survey published its first tide tables.

Each of the leading maritime nations now publishes tide tables annually, a year or more in advance, for the use of its navy and merchant marine. For our own country this important work devolves upon the Coast and Geodetic Survey which early in May of every year issues the tide tables for the whole of the following year. These tide tables now cover the entire maritime world and give for every day of the year the predicted time and height of high and low water at eighty-one of the more important ports of the world. In addition these tables also contain sufficient tidal data for some thirty-five hundred secondary ports, which, in connection with the daily predictions given for the principal ports, enable the American navigator to make use of any port in the world.

Underlying Principles

The tides, as is well known, are due to the gravitational action of sun and moon upon the rotating earth. The moon is the principal agent, or as the popular expression has it, "the tide follows the moon." This is due to the fact that the tide-generating force of a body varies directly as its mass and inversely as the cube of its distance from the earth. The sun has a mass almost 26,000,000 times as great as that of the moon, but because its distance from the earth is 389 times that of the moon's, its tide-producing power is to that of the moon as 26,000,000 is to $(389)^3$ or somewhat less than half.

While the mathematical expression for the tide-generating forces of the sun and moon may be derived without difficulty, the tides as they actually occur in nature have been so profoundly modified by terrestrial features as to bear little or no resemblance to the purely theoretical tide. In other words, while the tidal *forces* for any point on the earth may be computed from a general formula based on astronomical considerations, it is not possible to derive such a general formula for determining the time and height of tide. The tides at places but a short distance apart may be very dissimilar. To take but a single example: at the Atlantic end of the Panama Canal the tides have a rise and fall of about one foot, and at certain times of the month but one high and one low water occur during a day; at the Pacific end the rise and fall is from twelve to sixteen feet, and every day

there are two high and two low waters. The tides, then, are local phenomena, and the first step in the making of a tide table for any given port is to secure tidal observations at that port for a period varying from a month to a year or more. These observations may then be treated in two different ways known technically as the nonharmonic and harmonic methods. The former method is the simplest and the one used in the making of the earlier tide tables.

The Nonharmonic Method

This method is based on the close relationship existing between the time of tide at any given place and the moon's meridian passage. It begins by determining, from observations made at the port for which predictions are desired, the intervals elapsing between the moon's meridian passage and the times of tide. These time intervals, known respectively as the high-water and the low-water lunitidal intervals, have an approximately constant value for any given place and after having been once determined, say from a month or more of observations, may be used for making a rough tide table for that place by adding to the times of the moon's meridian passage as given in a nautical almanac.

The lunitidal intervals at any given place, as stated above, are only approximately constant. During a lunar month they undergo periodic changes, depending principally on the phase and declination of the moon. From long series of tidal observations these periodic changes may be determined; and by using these as corrections to the lunitidal intervals satisfactory predictions may be secured. It was by various modifications of the method as above outlined, with corrections for inequalities in the motions of sun and moon, that tide tables were computed for many years.

The heights of high and low water were predicted in a similar manner. The average heights for high water and for low water at the port for which predictions were desired were determined from observations. To the average heights corrections were then applied for changes in the phase and parallax of the moon, these corrections likewise being derived from observations. The tide tables produced in this way, although only approximately correct, worked quite satisfactorily for the Atlantic coast of the United States and for Europe. However, when applied to the prediction of tides of a different type, such as are found in the Pacific and Indian Oceans, the nonharmonic method necessitated so many corrections as to become prohibitive.

Types of Tide

The different varieties of tides occurring in nature may be divided into three types: semidaily, daily, and mixed. In the semidaily type, as its name indicates, there are two high and two low waters each day, high water and low water following each other at intervals of approximately six hours, the morning and afternoon tides being similar. To this type belong the tides on the Atlantic coasts of the United States and Europe.

At many places—as for instance: St. Michael, Alaska; Manila, Philippine Islands; Batavia, Java—we find a totally different type of tide. Here high water and low water will frequently be more than twelve hours apart; or, in other words, instead of two high and two low waters in a day, as on the Atlantic coast, there will be but one high and one low water in a day. To this type of tide the name "daily" has been given.

As a matter of fact, there is no place known where the tide is always of the daily type. At all places where this type predominates periods of one

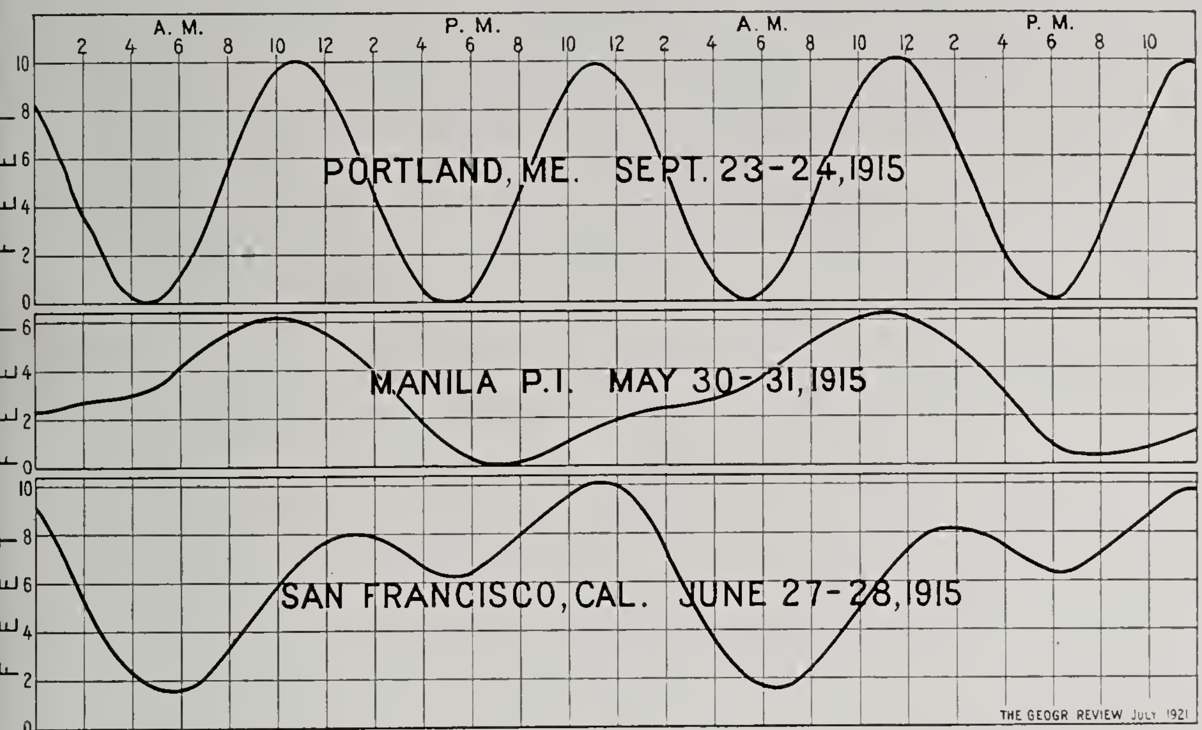

FIG. 1—Types of tide.

or more days occur during which there are two high and two low waters each day, these periods coming about the time that the moon's declination is changing from north to south or south to north. But, though two high and two low waters occur, they differ strikingly from the semidaily type in that the morning and afternoon tides are unlike both in extent and in duration of rise and fall. Such tides, having two high and two low waters each day but with morning and afternoon tides differing considerably, are known as the mixed type. This is the prevailing type on the coasts washed by the Pacific and Indian Oceans.

In the accompanying diagram the three types of tide are illustrated by plottings of hourly heights of the tide as observed for a period of two days in 1915 at Portland, Me., Manila, P. I., and San Francisco, Cal.

The tide curve for Portland exemplifies the semidaily type of tide. Beginning with the low water about 5 A. M., September 23, the water rises for a period of about six hours, falls for a like period, and repeats the cycle again in the afternoon and similar cycles the next day. In each case the rise or fall is about ten feet and takes place during an interval of about

six hours; in other words, both in extent and in duration of rise and fall the morning and afternoon tides are similar; and this is typical of the semidaily tide.

At Manila the tide is predominantly of the daily type, that is during the greater part of the time but one high water and one low water occur daily. Thus on May 30, 1915, high water occurred about 10 A. M., low water about 7 P. M.; and the next day likewise there occurred but one high and one low water.

The mixed type is illustrated by the tide at San Francisco for June 27 and 28, 1915. On both days we have two high and two low waters, but there is a striking difference between morning low water and afternoon low water and between morning high water and afternoon high water. This difference between morning and afternoon tides is of a twofold character: the extent of rise or fall is unlike and the duration of rise or fall is unequal. This difference between the two tidal cycles of the day is what distinguishes the mixed type of tide from the semidaily type.

For predicting the semidaily type of tide the nonharmonic method, as previously stated, gives satisfactory results. When applied to the prediction of the mixed type of tide this method, even where successful, necessitates an increase in the number of corrections to give passable results; but when tried for ports where the tide frequently becomes daily it falls down badly. Before the need for accurate tide tables covering the whole maritime world became pressing, a more effective method of treating and predicting tides was introduced. This, known as the harmonic method, is now used in the preparation of the tide tables issued by the United States government.

The Harmonic Method

If the motion of the moon around the earth and that of the earth around the sun could be made to take place in circular orbits in the plane of the equator with earth and sun as centers respectively, and, furthermore, if the lunar month consisted of an integral number of solar days, tidal prediction would be a very simple matter. It would only be necessary to observe the tides at any given port for a lunar month, and these observations would then constitute a very exact tide table for that port for the future; for the tide of any day of a lunar month would be exactly similar to the tide of the same day of any other lunar month. The actual motions of sun and moon are complicated; they can, however, be resolved into simple components; and this is what is done by the harmonic method. It substitutes for the sun and moon as tide-producing agencies a number of simple hypothetical bodies which, with respect to the earth, have circular orbits in the plane of the equator. Each of these tide-producing bodies is assumed to give rise to a tide of its own kind, and the tide as it actually occurs in nature is thus considered as being made up of a number of simple tides each of which has a period corresponding to the period of its particular, hypothetical tidal body.

The periods of revolution of the assumed tidal bodies, and therefore the periods of the simple constituent tides, are determined by astronomical calculations from the known motions of the moon and sun. These periods being independent of local conditions are therefore the same for all places on the surface of the earth; what remains to be determined for the various simple constituent tides is their phases and amplitudes, which vary from place to place according to type, time, and range of tide. The mathematical process by which these phases and amplitudes are disentangled from tidal observations is the very ingenious method known as harmonic analysis and is due to the brilliant and versatile physicist, William Thomson, better known as Lord Kelvin, who first proposed it in 1867.

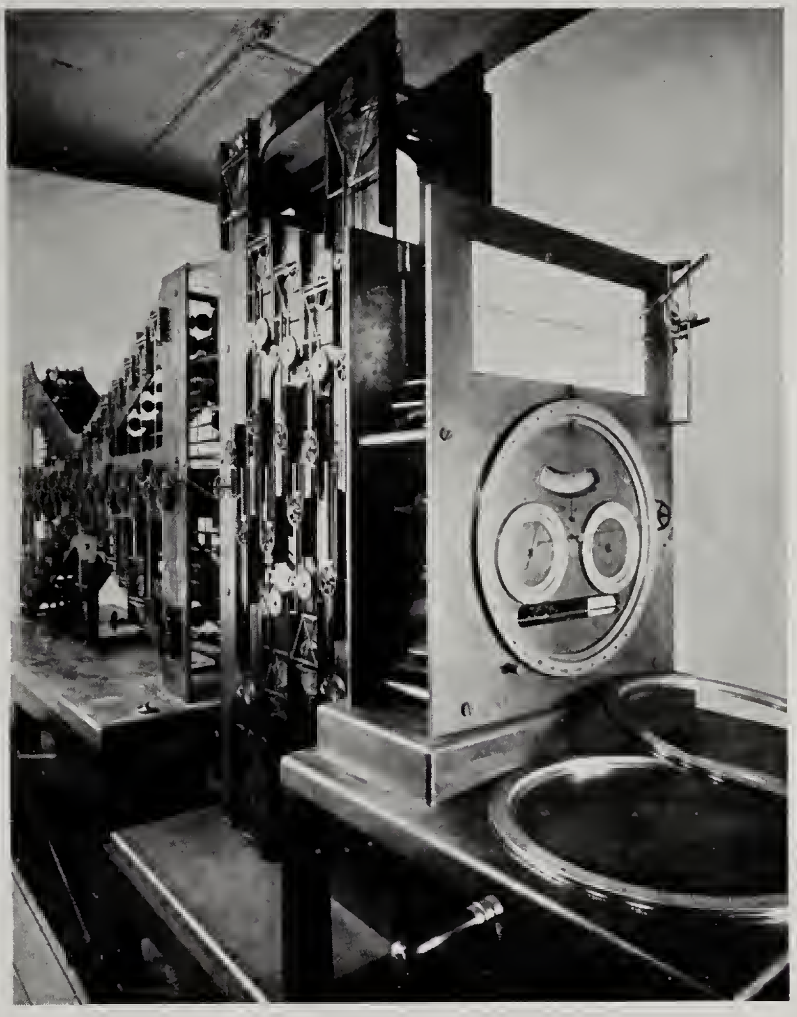

Fig. 2—Tide-predicting machine. On the machine the amplitudes of the constituent tides are set out on cranks, and the phases on dials. The height of tide due to any constituent tide is then given by the vertical motion of a slide on which is fixed a pulley with a chain working in the groove. This chain is made to travel over all the pulleys and thus sums instantly the constituent tides.

We cannot here enter into a detailed discussion of harmonic analysis. Unlike the nonharmonic method, which makes use of high and low waters only, the harmonic method makes use of the whole tidal wave, that is it uses hourly heights of the tide. The process, while not difficult, necessitates somewhat involved mathematical computations, out of which emerge the phases and amplitudes of the constituent tides sought. Though the theoretical number of these simple constituent tides is large, most of them are of such small magnitude that only between twenty and thirty need be computed to give tidal predictions of a high degree of precision.

Tide-Predicting Machines

Now it is obvious that the period, phase, and amplitude of a simple constituent tide being known, it is not a difficult matter to find the height of

tide due to that constituent at any given future time. Hence, to predict the tide that will occur at some future time, it is only necessary to add together the heights of the constituent tides at that time. The labor involved in doing this by ordinary methods of computation, however, is so great as to be prohibitive. In 1872 Lord Kelvin devised a machine which mechanically effects the summation of all the various tidal components and thus put tidal prediction by the harmonic method on a practical basis.

For the United States the tide tables until 1885 were predicted by the nonharmonic method; but in that year a tide-predicting machine, constructed on plans devised by William Ferrel, of the Coast and Geodetic Survey, and based on the harmonic method, was put into operation. This machine differed considerably from that devised by Lord Kelvin and was well adapted for predicting the semidaily type of tide. For more complicated tides the Ferrel machine did not work so well. In 1912 it was superseded by a new tide-predicting machine, devised and constructed in the office of the Coast and Geodetic Survey. A view of this machine is shown (Fig. 2). It has been described in the Survey publication entitled "Description of the U. S. Coast and Geodetic Survey Tide-Predicting Machine No. 2."[1] By the new Coast and Geodetic Survey tide-predicting machine a tide table giving the time and height of every high and low water for every day of the year for any port can be made in about ten hours.

Accuracy of Tidal Predictions

Obviously the value of a tide table depends on the closeness with which the predictions agree with the tides as they actually occur. It is evident, however, that absolute agreement is quite out of the question, for the times and heights of the tide are modified to a considerable extent by prevailing meteorological conditions. Heavy winds and sudden changes of atmospheric pressure will affect both time and height of tide; and, until the meteorologist is in a position to predict, a year or more in advance, the exact meteorological conditions that will prevail, the predicted tides in the tide tables cannot take account of such changes. Corrections based on local knowledge, however, may be applied to the predicted tides to allow for changes in wind and atmospheric pressure.

As a test of the accuracy of tidal predictions, observations and predictions at Portland, Me., and Seattle, Wash., were compared for the months of May and November, 1919. At Portland the tide is of the semidaily type and has a rise and fall varying from seven to thirteen feet. At Seattle the tide is of the mixed type with a rise and fall varying from less than two feet to more than sixteen feet.

At Portland for the month of May the greatest difference between the predicted and observed times of tide was four-tenths of an hour, or about twenty-five minutes. For the whole month 59 per cent of the predicted

[1] *U. S. Coast and Geodetic Survey Special Publ. No. 32*, Washington, D. C., 1915.

times differed by not more than one-tenth of an hour from the observed times of tide, and 94 per cent by not more than two-tenths of an hour. For November 74 per cent of the predicted times differed by not more than one-tenth of an hour, and 97 per cent by not more than two-tenths of an hour—the greatest difference again being four-tenths of an hour.

At Seattle for May 56 per cent of the predicted times of tide differed by not more than one-tenth of an hour from the observed times, 78 per cent by not more than two-tenths of an hour, and 99 per cent by not more than three-tenths. Here, too, the greatest difference was four-tenths of an hour. For November 47 per cent of the predictions differed from the observations by not more than one-tenth of an hour, 78 per cent by not more than two-tenths, 99 per cent by not more than three-tenths; while the greatest difference was four-tenths of an hour.

It should be stated that no corrections were applied to the predicted times of tide for changes in meteorological conditions. Furthermore, it is to be remembered that near the times of high and low water the height of the tide is changing very slowly and that it is not practicable to determine the time of the observed high or low water with a precision greater than that represented by a tenth of an hour. Therefore a difference between observations and predictions of two or three-tenths of an hour is of little consequence, especially for practical purposes.

The study of the tides has engaged the minds of many brilliant mathematicians since the time of Newton and still constitutes a fertile field for investigation. The outstanding problems do not relate to the determination of the tidal forces, for these are known; they are altogether of a hydrodynamical character and are concerned with the motions of existing bodies of water as influenced by known tidal forces. As regards the prediction of tides, however, in so far as this is based on previous observations, the problem may be considered solved.

NEW ORLEANS AT THE TIME OF THE LOUISIANA PURCHASE [1]

By Edna F. Campbell

At the time of the Louisiana Purchase (1803) population in the United States was, with a few exceptions, largely confined to the Atlantic seaboard. Among the exceptions was New Orleans, which was the focus of the life of the Mississippi Valley, as indeed it had been since the early days of settlement. The New Orleans of these early days has been sketched in a previous article.[2] Development of the town was slow despite the natural productivity of the region which made for a certain ease of life. Colonial policy both under the French and the succeeding Spanish domination was unfavorable; and, furthermore, the colonists suffered from certain natural handicaps. Uncertainties of weather affected the crops, notably indigo, which for a time was the staple cultivation. The topographic conditions of swamp and forest impeded expansion, and still more powerful was the factor of geographic isolation.

In the Mississippi Valley all roads led to New Orleans, and the ease of reaching its markets was a powerful deterrent to the growth of other towns

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[1] The main sources used are:

An Account of Louisiana, 1803. Being an Abstract of Documents in the Offices of the Departments of State and of the Treasury, *Old South Leaflets*, Vol. 5, pp. 89–116, Directors of the Old South Work, Boston, 1902.

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Amos Stoddard: Sketches, Historical and Descriptive, of Louisiana, Philadelphia, 1812.

[2] Edna F. Campbell: New Orleans in Early Days, *Geogr. Rev.*, Vol. 10, 1920, pp. 31–36.

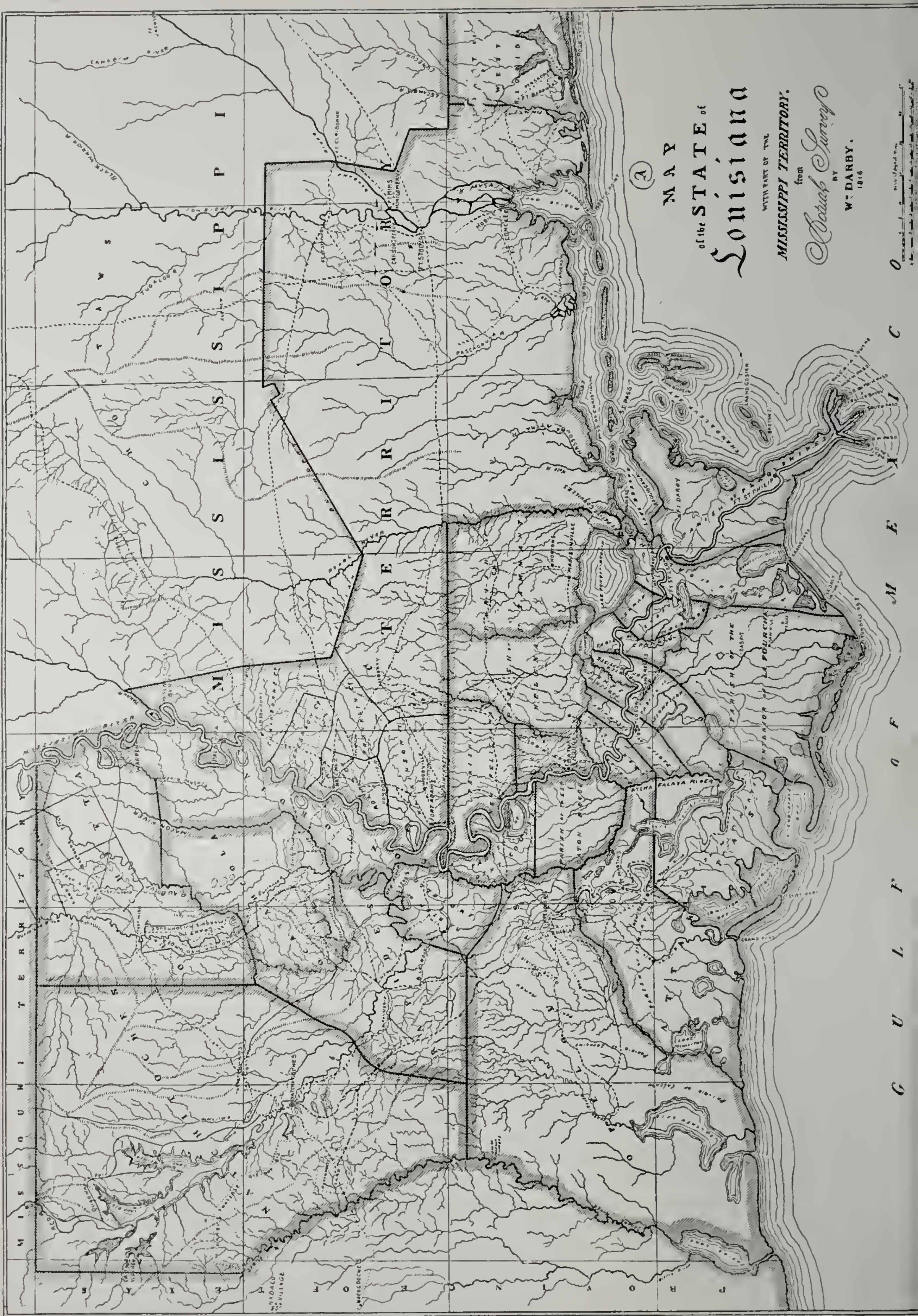
in the "Delta." As commonly spoken of by the writers of this period, the country south of the Atchafalaya-Red confluence on the right side of the Mississippi River was the "Delta." In this section the valley west of the river is many times larger than the eastern part, and in no place is the river bordered by bluffs. Natural levees and the scattered prairies afforded locations for settlers.

Distribution of Population in Lower Louisiana

At the time of the cession three-fourths of the population and seven-eighths of the wealth of Louisiana were concentrated in the Delta. It is somewhat difficult to give precise figures. Estimates vary widely; probably in large part because of the character of the population, only about half of which was regularly settled. The population of Lower Louisiana (i.e. south of latitude 31° N. and from the Perdido River to the Sabine River) may be placed at about 60,000, exclusive of Indians.[3] Rather more than half, about 32,000, occupied the margin of the Mississippi; and of these between 8,000 and 12,000 were in New Orleans. The La Fourche region and the strip extending through Bayou Sara, Natchitoches, and Avoyelles each had about a tenth; the prairies of Opelousas and Attacapas contained nearly a fifth. The remainder occupied the high land in the vicinity of Lake Pontchartrain. Of this population little less than half were whites. The percentage of the blacks was rapidly increasing as the restrictions on their importation were being lightened. In more detail the distribution may be characterized as follows.

From Pointe Coupée parish, below the egress of the Atchafalaya from the Mississippi, settlements were continuous on the right side of the river to within 20 leagues of the Gulf. On the left, plantations beginning a short distance below Iberville bordered the river to about the same distance from the Gulf and about 27 miles below New Orleans. Sixty miles below New Orleans were Fort Plaquemine on the one side and Fort Bourbon on the other, marking the limit of settlement. At this point the swampy morass set a barrier to further extension. Settlement was such on both sides of the river as to give the appearance of a continuous village along the entire strip, but it was thinner on the right than on the left side. The best plantations were above and near New Orleans on the left side. On an average of about half a mile to a mile back from the river the plantations gradually merged into impassable cane and cypress swamps. The levees bordering the numerous bayous also afforded opportunity for settlement. Of such, three were of chief importance. The La Fourche had 200 families, mostly poor Spanish, scattered along its banks for some 45 miles. The Plaquemine, flowing from the Mississippi about 30 miles farther north, and the Atchafalaya, 130 miles still farther north, were similarly settled.

[3] Robertson, Vol. 1, pp. 149–150.


MAP
of the STATE of
Louisiana
WITH PART OF THE
MISSISSIPPI TERRITORY.
from
Actual Survey
BY
Wm DARBY.
1816
MISSISSIPPI TERRITORY
MISSOURI TERRITORY
GULF OF MEXICO

Along the Plaquemine only the left 20 miles below the efflux of the Atchafalaya were settled; elsewhere the danger of inundation precluded settlement.

On the east side of the valley similar conditions of bordering levees, cane swamps, and salt marshes existed throughout the area, with the exception of a dry strip of excellent land about a mile in width, extending from the Mississippi some ten or twelve miles below New Orleans eastward to the lakes. Here there was a poor settlement, known as Terre aux Boeufs, composed of about 800 Spanish who raised produce for New Orleans. The wealthy planters occupied the alluvial margin of the Mississippi, where the most valuable lands were on the projections of the river curves.

To the west and southwest of the Mississippi the "Coasts" of Opelousas and Attacapas were a network of bayous and swamps interspersed with strips of prairie. Opelousas covered about 7,600 square miles, and Attacapas 5,100, while other small coasts were Calcasieu, Grand, and Mamon. Most of the inhabitants of Attacapas lived along the Teche and the Vermilion. Of a great number of Americans who came into the region after the Purchase, many entered by way of the Atchafalaya; for it was estimated that the distance from the western states to the Gulf could be shortened more than 120 miles by descending that stream rather than the Mississippi. Furthermore, it was easier of entry.

Growth of Population

Pontalba had urged in 1800 that what was needed in Louisiana was working hands.[4] His contention was proved in the early years of the century. In the twenty-five years preceding 1810 the population more than doubled, rising from 37,000 in 1785 to nearly 76,000 in 1810;[5] and by 1820 to almost 154,000.

The remarkable growth was chiefly due to the opening up by the Purchase of a vast extent of fertile land. Here was an opportunity for the restless Americans in the period following the Revolution. Emigrants came especially from Kentucky, Tennessee, Georgia, western Pennsylvania, and the Carolinas. Excitement connected with Burr's movement on the Mississippi River brought hundreds to the valley. Refugees from war-harassed Europe added to the number. Much advertising was given the region by numerous publications, especially Jefferson's widely circulated pamphlet, the "Account of Louisiana." The majority of incomers were engaged in commercial pursuits, and such crowded along the Mississippi. The second great class of immigrants came to make homes and started their little plantations wherever was available fertile soil, combined with sufficient elevation for protection from flood.

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[4] Gayarré: History of Louisiana: The Spanish Domination, pp. 410–445.

[5] Timothy Flint: The History and Geography of the Mississippi Valley, Vol. 2, p. 233.

Pastoral Lands

The borders of the swamps were suitable for cattle and swine to range, and immense herds of cattle and horses and large flocks of sheep ranged the prairies as well. Darby spoke of these prairies as among the "meadows of America." The *vacheries*, as they were called, were the greatest in the United States by 1810. As many as 15,000 to 20,000 head of cattle and horses were brought from the Spanish provinces to North America, and Spanish methods in caring for them were used. Conditions were favorable for such an industry. Salt was cheap, being obtained from wells sunk in the Petite Anse hill along the coast. Wells fifty feet deep supplied water, as that from fresh springs on the prairie was inadequate. The meadows furnished an abundance of food, and little shelter was needed. It was estimated that the value of a *vacherie* doubled every four years, and that of a cotton plantation every three years.[6]

Agriculture

Preparation of the ground for planting was a more difficult matter than in the north, necessitating more labor and hence more capital. If it were not a canebreak bottom, clearing involved the burning of a dense undergrowth of shrubs, thistle, and thorns. Cotton and sugar were the staple crops. Within a hundred miles north and fifteen miles south of the city sugar was the great crop. An acre of cane produced from 1,000 to 1,200 pounds of sugar and 50 gallons of rum. The sugar crop of 1802 yielded 5,000 hogsheads of 1,000 pounds each of sugar and 5,000 casks of molasses of 50 gallons each.[7] At the time of the American occupation there were between 60 and 80 sugar plantations in the valley, and of these more than three-fourths were above New Orleans.

Cotton was grown widely, but the best sections were the upper part of Baton Rouge, Attacapas, Opelousas, and Pointe Coupée. Little else was grown by the rich and populous settlement of the last-named section. The cotton was fine but of short fiber. About 250 pounds, valued at 20 cents a pound, were grown on a single acre. In 1803 the production was 20,000 bales of 300 pounds each.[8]

In other parts of the valley the planting was more varied. Proprietors of large plantations grew cotton, while the owners of the smaller ones, many of whom were Germans, planted rice. Because of the need of water for flooding the fields, rice was grown only near the streams.

Agricultural Trends in Colonial Days

A gradual evolution in agriculture had taken place in the valley. The chief crop of the first French planters had been indigo, a cultivation well

[6] Stoddard, pp. 182–183.

[7] Monette, History of the Discovery, etc., Vol. 1, p. 566.

[8] Martin, Vol. 2, p. 234.

adapted to the character of the land, for the vigorous taproot of the plant easily penetrates hard, packed, marly soil. The crop, formerly reaching a total of 300,000 pounds, was reduced by the year 1800 to 100,000 pounds and thence diminished rapidly, amounting to only 3,000 pounds in 1803.[9] The year of the locusts, 1794, had marked the climax of indigo production, after which cotton came gradually to replace it. There were other factors involved in the change. The damp climate of Louisiana was unfavorable. A glut of indigo on the European market lowered prices, and at the same time use of the saw cotton gin and advance in cotton prices favored the latter production.

Although indigo was abandoned by most of the planters, it still was grown by some, for there was prevalent a belief that a rotation of sugar and indigo made the planting of the latter practicable. The impression was current that the sugar cane destroyed the insects that were fatal to the indigo.

There was a further tendency to replace cotton by sugar where climatic conditions were favorable. A writer in *Niles Weekly Register*, commenting in December, 1815, on the change from cotton to sugar, spoke of the cane as more desirable, "being less liable to disease and accident, and requiring less labor to bring it into market, one acre in cane being also equal in value to three acres in cotton." "The Navigator" credits the planters with the statement that one-fourth of the cultivated land of any considerable plantation may be planted in cane, one-fourth left in pasture, and the other half used for provisions, etc., and a reserve for a change of crops.[10]

An economic evolution paralleled the agricultural. Indigo, cotton, sugar involved, in turn, greater capital. The first Americans to come into the valley after the Revolution were poor. Indigo required the least capital and labor of the three great staples. A gradual accumulation of money made possible the purchase of slaves, an increase in extent of landholdings, and the profitable cultivation of great cotton and sugar plantations. Consequently sugar was planted by the more wealthy proprietors and cotton by the poorer.

At the time of the Purchase there still persisted the belief that the valley held possibilities in the culture of the vine and the olive; for the similarity in climate to that of southern France was yet in mind. To test the possibility, the United States Government granted a tract of land to a company of French immigrants on condition that they should "introduce the culture of the vine and olive." In a discussion of the project, a writer of the period remarked "that from the time the ark rested on Mt. Ararat to the present day, wine has never been made to any great perfection upon the alluvial soil of large rivers." [11]

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[9] *Ibid.*, Vol. 2, p. 234.

[10] Cramer, p. 338.

[11] Darby, The Emigrant's Guide, etc., p. 22.

New Orleans As a City

The valley was conspicuously a one-city region, no other center than New Orleans having as much as one thousand population. New Orleans owed its importance principally to its situation. The site, on the other hand, had many disadvantages. It was low; and the inhabitants, especially during the weeks of early summer, lived in fear of the river. Breaks in the levee were frequent. The expense of its repair and maintenance was high but was met in part by an anchorage duty of six dollars. Problems of sewage disposal and water supply were likewise serious. It was to conditions of filth, lack of drainage, and improper living that the contemporary writers attributed the prevalence of disease, for it was agreed that the climate was wholesome. Yellow fever did not appear in the valley until 1767. The disease was unknown in the country districts, where large families and longevity were the rule.

The situation of New Orleans offered compelling commercial advantages. It commanded the trade of the Mississippi River system, which included a maze of bayous that linked it with every settlement. It was the outlet for a fertile, almost level country more than 1200 miles in length from north to south and averaging 200 miles in width. It was only a short distance from the sea, at this period about 100 miles, and was accessible to ocean vessels. Trade with the West Indies and Mexico, for which the port was conveniently placed, was important at this time.

Furthermore, New Orleans was a double port, the second connection being furnished by the Carondelet Canal by means of which easy access was given to the region immediately to the northeast and an important source of lime, tar, pitch, lumber, and fish. The harbor was good. Its crescent shape afforded protection, as in the case of Natchez. Tides had little or no effect, but the depth of the river permitted the discharge of cargo by means of a bridge supported by two forty-foot spars.

Other Population Centers

Excepting Natchez, all other centers were purely local. The occasion of each was the parish church, and the geographical feature that determined its site was either the high land of a levee margining the stream that provided transportation, or the intersection of an upland prairie by such a channel or by one of the few roads in the valley, or the junction of two of the streams.

By 1810 the only towns in the Delta other than New Orleans, worthy of the name, were Madisonville, the port on Lake Pontchartrain, at the junction of the Amite and Iberville; Donaldsonville, at the efflux of the La Fourche; Springfield, a resting place between Natchez and Madisonville; and Baton Rouge.

Industrial Conditions

At the time of the Purchase, there were but few manufactures. These were connected largely with the agricultural products and were of the most

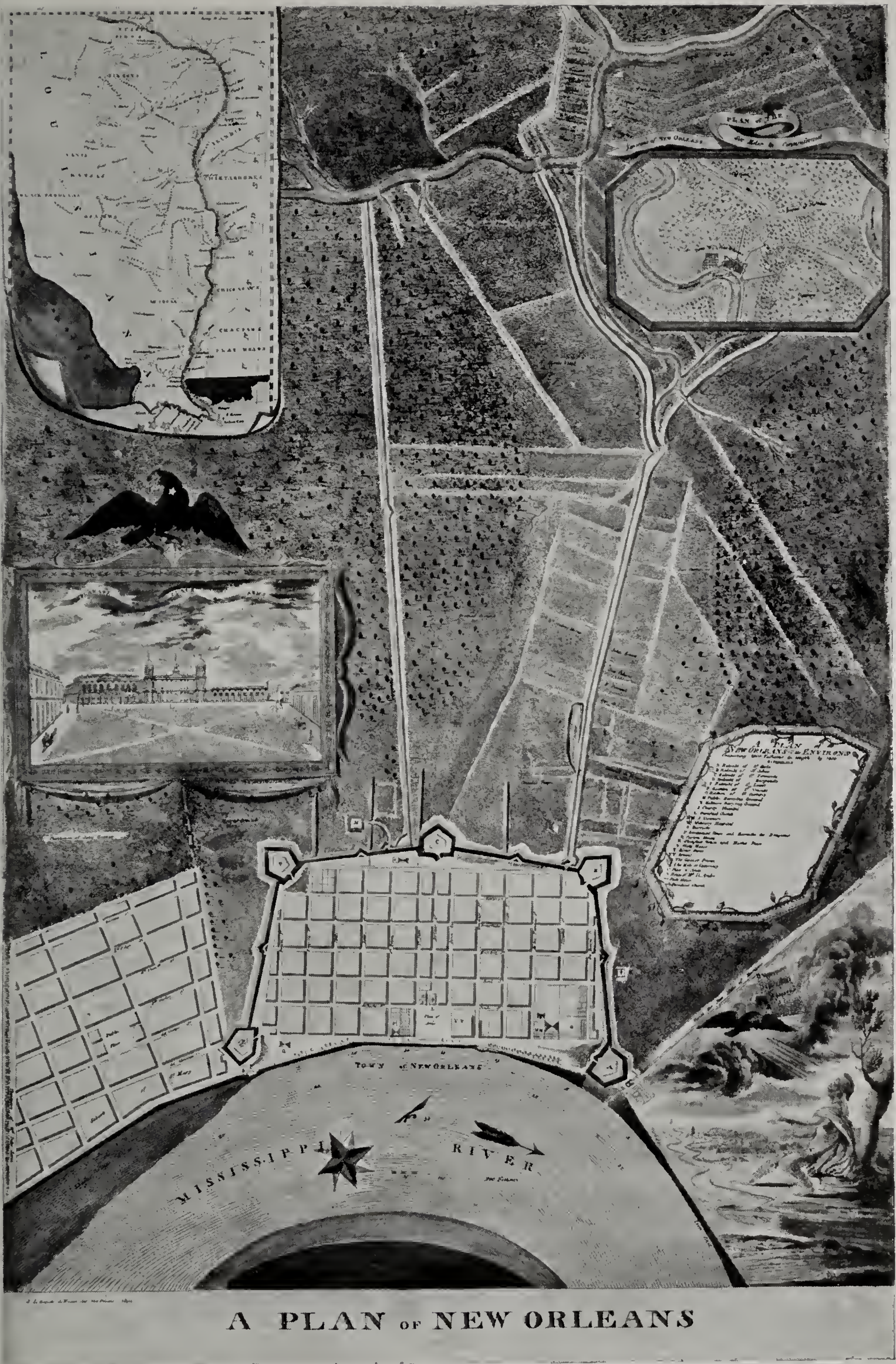

FIG. 2—Boqueta de Woiseri's plan of New Orleans in 1803. The original is 18¾" x 27".

primitive kind. Exorbitant prices of foreign manufactured textiles encouraged domestic industry. Women slaves were employed in spinning and weaving, and men slaves as carpenters and smiths. There were but two machines for spinning cotton, one in Opelousas and one in the parish of Iberville, and these were not always in operation.[12] In the suburbs of New Orleans there was a cotton mill capable of cleaning and baling a thousand pounds of cotton daily. This was one of the large public cotton gins in the valley. To such gins the proprietors of small plantations in the lower part of the valley brought their cotton. At New Orleans there were also a cordage factory and several factories for shot and for hair powder.

The great stock farms of Opelousas and Attacapas gave rise to an important tanning development. Little dairy produce was made in that section, however. Most of the surplus butter and cheese came from the Red River district, from which much was exported.

Aside from cotton ginning and the tanning of hides, the only industries of any significance were sugar refining and lumber milling. In 1796 there were 10 sugar refineries in the valley.[13] One of these, located at New Orleans, produced yearly about 200,000 pounds of loaf sugar. Tafia, a kind of rum, was an important by-product. In the vicinity of New Orleans there were 12 distilleries, manufacturing more than 200,000 gallons yearly. Rapid expansion of sugar planting and the influx of a large number of refugees from Santo Domingo skilled in the manufacture of sugar led to a rapid growth of refining.

The most important industry at this period was the milling of lumber and the making of boxes for shipping sugar. In the slack season of autumn planters sent their slaves to the cypress swamps in the rear of their plantations. The squared timber was floated down the Mississippi by means of ditches cut through the swamp for the purpose. As the nearer sources were exhausted much timber also was cut from the unclaimed cypress swamp between New Orleans and Pointe Coupée and was floated on rafts down to New Orleans. Planters cut mill races through the levees and erected mills on them which, during flood time, were worked night and day. There were about 30 of these mills near New Orleans. Boxes, most of which were exported to Cuba and Havana, brought a revenue of more than $100,000 yearly to the planters.[14]

Much timber, especially cypress[15] which was much in demand for building purposes, had been taken from the islands in the river by the beginning of the nineteenth century. It is interesting to note that as early as that time a writer commented on the taking of timber from public lands as improper and urged that an effort be made to prevent the wasteful use of lumber. This was probably one of the first suggestions for the conservation of timber in this country.

[12] Martin, Vol. 2, p. 234.
[13] Robertson, Vol. 1, p. 154.
[14] Gayarré, History of Louisiana: The Spanish Domination, p. 439.
[15] Darby, A Geographical Description, etc., p. 74.

Commercial Conditions

Commerce in the region, up to this time, was one-sided. Exports, though gradually increasing during the later colonial period, never equaled imports in value. The year before the Purchase exports by way of the sea amounted to about $2,160,000, and imports to $2,500,000.[16] As New Orleans was the port of the entire western country the total exports, amounting to nearly 40,000 tons, included part of that output as well. The principal items were flour, 50,000 barrels; tobacco, 2,000 hogsheads; salt beef and pork, 3,000 barrels; cotton, 34,000 bales; molasses, 800 casks; sugar, 4,000 hogsheads; peltries, naval stores, and lumber.[17]

Commercial relations were established not only with European countries but with Cuba, Santo Domingo, and American towns as well. The latter commerce included a coasting trade with Atlantic and Gulf ports and an exchange with the western country.

Until 1800, French vessels made exchanges chiefly with Bordeaux, Marseilles, and Nantes. By 1802, American and Spanish vessels had largely replaced the French.[18] The rapid increase in sugar and cotton planting led to more than a tenfold increase in the number of vessels.

The small commerce reflected the small production, which was limited to lumber, agricultural products, and furs. The English had managed to secure control of the fur trade, and the Spanish had no great incentive in that direction, as furs were not in great demand in Spain. Not until the great staples, sugar and cotton, began to dominate the planting was there an important agricultural surplus.

Down-river trade at the close of the period preceding the steamboat was estimated at $15,000,000. Besides this about 50,000 bales of cotton and 15,000 hogsheads of sugar from Mississippi and Louisiana were exported from New Orleans. Exports from New Orleans averaged $2,000,000. At the same period about 500 vessels entered yearly from domestic and foreign ports.[19]

Traffic on the Mississippi River

The basis of early French settlement in North America was the fur trade, and, in the absence of roads, the superficial exploitation of the country was based on the streams, on whose borders all the settlements were to be found.

Until 1720 it was largely furs that made up the cargoes on the Mississippi and its tributaries. About this time the nature of the traffic changed. The Illinois colonists in the southern end of the valley needed the foodstuffs produced above. To the growing town of New Orleans French ships were bringing merchandise and supplies, making it the commercial center of the valley. To handle the resulting trade barges, "keels", and flatboats were used.

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[16] Stoddard, p. 296.
[17] Martin, Vol. 2, p. 236.
[18] *Ibid.*, Vol. 2, p. 234.
[19] Monette, The Progress of Navigation, etc., p. 515.

The long, narrow keel boats ("keels") carried from fifteen to thirty tons. They were light in weight, of small draft, and were propelled by oars, sails, setting poles, cordelles, and by bushwhacking.[20] Bushwhacking, or pulling along by the bushes, was the method used when the boat ran close to the margin of the stream in high water. The "Kentucky flats," or "broadhorns," were arks from fifty to eighty feet long and fifteen feet wide, capable of carrying from twenty to forty tons. Many of them were protected from rain by slightly curved roofs. They were more unwieldy than the keels and could not be used in such shallow waters. Five men, on an average, were required to navigate one.

The barges were the largest of these boats and carried from fifty to a hundred tons. They were fitted with sails somewhat like those of a schooner. In ascending the Mississippi, when the wind did not serve, the unwieldy craft was warped upstream by means of two yawls. This required from thirty to thirty-five men, and only six to eight miles a day could be covered. The journey from New Orleans to Cincinnati, thus made, consumed from ninety to a hundred days.[21]

Navigation of the river was laborious and dangerous, but despite all difficulties traffic on it grew rapidly in the latter half of the eighteenth century and the first quarter of the nineteenth. Not till the Louisiana Purchase, however, was trading sufficiently safe to point its steady development.

Until about 1820 the trade of the lower Mississippi originated largely in the Ohio basin, inasmuch as settlement was most advanced in that region. Much flour was produced, for which the natural market was New Orleans. Louisville was the starting point for most of the boats, and the journey from that point to New Orleans required from thirty to thirty-five days. The surplus products of the settlements along the Monongahela, the Ohio, the Kentucky, and the Cumberland consisted of flour, pork, whiskey, apples, cider, lumber, horses, cattle, and lime. Of these, flour was by far the most important. In 1824 Ohio shipped 300,000 barrels of flour, amounting to one-fourth the value of all the products descending the Mississippi.[22]

The Missouri River valley contributed little other than peltries to the traffic of the Mississippi. The Indian trade of Upper Louisiana proved highly profitable; but south of the thirty-second parallel it served only to impoverish the valley and retard its development, for it diverted attention from agriculture, and the furs were of comparatively small value.

Spring and autumn were the busy seasons for the boatmen engaged in the trade on the Mississippi. Every considerable farmer in the "western country," or Upper Louisiana, built his boat each season to send his surplus to the New Orleans market. Only a few of these boats ever returned owing to the laborious nature of the upstream journey, in which human en-

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[20] Timothy Flint, Recollections, etc., p. 91.

[21] *Idem*, The History and Geography of the Mississippi Valley, Vol. 1, pp. 151–152.

[22] F. H. Dixon: A Traffic History of the Mississippi River System, *Natl. Waterways Commission Doc. No. 11*, Washington, D. C., 1909, p. 17.

ergy was the power. Furthermore, the expense was a large item, the cost of cheap, heavy articles being doubled by the freight charges. Dry goods, hardware, and similar articles could be brought by wagon to Pittsburg from Baltimore and Philadelphia more cheaply than by water from New Orleans. In many cases the boatmen returned by land, leaving the Mississippi at Natchez and taking forty-five days for the 1,100-mile trip back to Lexington. So arduous was this that many of the boatmen returned by sea from New Orleans to Philadelphia or New York.[23]

In the second decade of the nineteenth century the advent of the steamboat wrought a marvelous change in the life of the pioneers and in the character of the traffic on the Mississippi River. In 1817, 1,500 flatboats and 500 barges brought produce to New Orleans; by 1821, 287 barges came regularly to the city. The Faubourg St. Marie was the trade center. On account of slack water in front of its *batture* the flatboats moored there. Strife between Creoles and Americans gave rise to three municipalities, the old town of "Vieux Carré," the Faubourg St. Marie (a suburb), and the Faubourg Marigny (a suburb). The governments of each were distinct, but there was a Mayor and Council for the whole. Vieux Carré was the Creole section, retaining control of the trade in coffee, indigo, sugar, rice, foreign fruits, and wines; while cotton, tobacco, pork, beef, corn, and northern British goods were received in the American section. In 1825 the commerce of New Orleans was worth $17,000,000. In 1835 it had trebled. By 1840 New Orleans was the fourth city in population in the United States.

The decades 1840–1860 were flourishing times for New Orleans. Very considerable drainage was effected by the New Basin and Melpomene Canals. A tide of European immigration was flowing in at the rate of 300,000 yearly, of which a large percentage was German. The first railroad of the region (1820–1830), and one of the earliest in the United States, connected New Orleans with Lake Pontchartrain;[24] and the New Orleans and Nashville and the Mexican Gulf came into existence in the later thirties. By 1860 two railroads joined New Orleans with the railroads of the Mississippi Valley and Texas. The first was to Jackson, Miss., and the second to Opelousas, La.

Receipts from the interior jumped from $45,700,000 in 1842 to $107,000,000 in 1851. New Orleans and the valley were humming with prosperity. The steamboat had done much to nullify the influence of geographic isolation. The course of progress in the valley seemed open to an almost unlimited development though, as transpired, other influences entered shortly that turned the stream of commerce away from New Orleans.

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[23] Michaux, p. 182.

[24] Henry Whittemore: Fulfilment of Three Remarkable Prophecies in the History of the Great Empire State Relating to the Development of Steamboat Navigation and Railroad Transportation 1808–1908, [Brooklyn? 1909?], Part II, pp. 23, 25.

THE DISMEMBERMENT OF HUNGARY

By B. C. Wallis

From the standpoint of nationality the old kingdom of Hungary was a Magyar nucleus within a group of "subject nations." The relations between the dominant and the subject nationalities formed the theme of a statistical analysis by the writer. The results which were published in the *Geographical Review* [1] may now be re-examined in respect to the changes arising from the dismemberment of Hungary.

The old state has been split into the new Hungary—roughly comprising the Magyar nucleus—and Fiume as sovereign states and into components of four encircling states, comprising in the main the subject nationalities. The German west has gone to Austria, the Slovakian and Ruthenian north to Czecho-Slovakia, the Rumanian east to Rumania, and the Slav south to Yugo-Slavia. Utilizing the census of 1910, and the boundaries of the new states with as much precision as is possible, Table I indicates the proportions of area and population between the distributed parts.

Table I—Shares, in Area and Population, of the Distributed Parts of the Former Kingdom of Hungary

States	Area		Population		Density per Square Mile
	Thousands of Square Miles	Percentage	Thousands	Percentage	
Hungary	36	28	7,540	36	209
(Budapest)	—	—	(880)	(4)	—
Austria	1.6	1	330	2	206
Czecho-Slovakia	24	19	3,560	17	148
Yugo-Slavia	25	20	4,200	20	168
Rumania	40	32	5,210	25	130
Fiume	—	—	50	—	—
Total	126.6		20,890		

The Rumanian section is the largest and the least densely peopled; the Austrian section, excepting Fiume, is the smallest and nearly the most densely peopled. The new Hungary is less than a third in area with more than a third of the population of the old kingdom. The two Slav sections,

[1] B. C. Wallis: The Rumanians in Hungary, *Geogr. Rev.*, Vol. 6, 1918, pp. 156–171; The Slavs of Northern Hungary, pp. 268–281; The Slavs of Southern Hungary, pp. 341–353; Central Hungary: Magyars and Germans, pp. 421–435. See also "The Peoples of Hungary: Their Work on the Land," *Geogr. Rev.*, Vol. 4, 1917, pp. 465–481.

in the north and the south, are almost equal in area; but the southern contains more people. The new boundaries are of considerable interest. They substitute arbitrary lines for natural features, except along the Danube below Pressburg and along the lower Drave. They cut across the natural districts; the little and great Alföld, the Banat, and the Bačka are not entirely within one new state; Rumania has received more than the Transylvanian plateau; Yugo-Slavia more than the mesopotamia of Croatia-Slavonia. Furthermore, they ignore the administrative lines which have been developed in the old Hungary; they rarely coincide with the old boundaries of counties or districts (*jarasi*); and they divide, sometimes, the territorial area in possession of the great Alföld towns.

It is extremely interesting to follow the sinuosities of the new limits in relation to the character of the inhabitants of the adjacent villages and small towns and to note how, at times, places with a German majority are given to Austria while neighboring Magyar villages remain to Hungary. In general, the lines, as will be seen later, lie within the boundary zones where the population is not entirely of one race. The principle of nationality, however, is not the sole factor determining the run of the lines, as is seen from the results shown in Table II.

TABLE II—POPULATION BY NATIONALITIES OF THE DISTRIBUTED PARTS OF THE FORMER KINGDOM OF HUNGARY

(*In thousands*)

STATE	TOTAL	MAGYAR	GERMAN	JEWISH	SLOVAKIAN	RUMANIAN	RUTHENIAN	YUGO-SLAV	OTHER
Hungary	7,540	6,250	480	460	180	50	—	50	70
(Budapest)	(880)	(583)	(48)	(204)	(20)	(3)	—	(7)	(15)
Austria	330	25	235	20	—	—	—	50	—
Czecho-Slovakia	3,560	955	120	270	1,720	10	430	5	50
Yugo-Slavia	4,200	560	460	40	60	70	10	2,850	150
Rumania	5,210	1,550	520	138	10	2,820	20	50	102
Fiume	50	5	2	2	—	—	—	15	26
Total	20,890	9,345	1,817	930	1,970	2,950	460	3,020	398

Until the boundaries shall have been finally laid down, and the new censuses taken, the figures of the 1910 census are the only safe guide. Consequently the estimates in Table II are only approximate; at the same time, as in the writer's previous papers, the census returns have been recast in order that the Jews might be estimated as a race. On this basis the new Hungary contains but two-thirds of the Magyars. It is probable, however, that the numbers of Magyars in the other states will show some relative decrease, since the Magyar officials and their families will not find further

employment among the late "subject races;" but the Szeklers of Transylvania and the Magyars north of the Danube in Czecho-Slovakia will, many of them, remain outside Hungary. The Magyars form four-fifths of the population of the new Hungary, the largest minorities being Germans and Jews. There is no reason to suppose that the Germans who live in the ethnic islands near Lake Balaton and near Budapest or that the Jews who are mainly urban people will forsake the new state. The new Hungary remains the most densely peopled area in the old Hungary; and the large population of Budapest and the comparatively populous towns Szeged, Debreczen, Miskolcz, Kecskemét, Hódmezö-Vásárhely give a proportional excess of town dwellers.

In the Czecho-Slovakian section half the people are Slovaks, and one-eighth are Ruthenes. The minorities are large, especially in the case of the Magyars. The Jews are scattered over the east where they will probably remain. This section is likely to lose population on the whole, since the Magyars will tend to decline in numbers and there is no very great reason to suppose that the Slovak and Ruthene will cease to migrate or emigrate. It may be argued that the Slovak, once free from Magyar despotism, will become more stay-at-home; but the new state is pledged to an uplifting educational and social policy, which will tend to unsettle the next generation of these Slavs. The dour existence among the Carpathians will not attract in face of the easier life of the plains; the Slovak may migrate to Moravia or Bohemia instead of to the Alföld; but he will, almost certainly, move away from the hills. The Yugo-Slavs number less than three-quarters of the people in the Yugo-Slavian section. The Magyar minority will decline, the Germans of the Bačka and Banat will remain, and the other minorities are comparatively trifling. The new boundaries have untied politically some 95 per cent of the Yugo-Slavs of the old Hungary; so that, unless Yugo-Slavs migrate from Serbia and Bosnia to the more fertile lands beyond the Save, the population of this section will remain little altered.

Nearly all the Rumanians of the old Hungary are now Rumanian citizens; but at the same time the new conditions give to the enlarged Rumanian state considerable Magyar and German minorities, relatively great numbers of "foreigners." These people will almost certainly remain in their villages and townships.

In Fiume the Italians form the most numerous section of the population, which will probably remain with little proportional change.

A detailed examination of the new boundaries in relation to a nationalities map of Hungary reveals some interesting facts. The results as regards the Magyars are of the greatest importance. On the west, between the Drave and the Danube, the boundary gives Hungary some Germans and Croats but does not give to Austria any Magyars. By contrast, on the east, between the Tisa and the Maros, the boundary almost entirely cuts across territory where the people are above 95 per cent Magyar; e.g. Szatmár-Németi, Nagy-Károly, Nagy-Várad are definitely Magyar towns. The new Rumanian

territory includes not only the highlands of the Bihar massif but an area sufficiently far into the Alföld to include the towns and villages which control the valleys leading down to the north and the west of the massif—a strip whose inhabitants are Magyar. South of Szeged the Magyars have lost a Magyar area including Zenta, Topolya, and Péterréve which is included in Yugo-Slavia; but elsewhere on the south Hungary includes the Magyar population. In the north there is a great contrast. Almost from Pressburg (Bratislavá) eastwards to the Ipoly the area for 20 miles north of the Danube is Magyar; the linguistic boundary lies north of parallel 48° N. The remainder of the northern boundary from the Ipoly across the Sajó, Hernád, and Ung valleys to the northeast corner lies well within Magyar territory.

The common boundary between Rumania and Czecho-Slovakia is, on the whole, just to both nationalities; on the balance, too, the boundary of Rumania with Yugo-Slavia gives to each nationality its own villages, with perhaps a larger share of the German areas to Rumania. The latter state has been well served by the boundary makers. Practically the whole of the definitely Yugo-Slav territory is included within the new state, which has a distinct gain in the possession of Szabadka (Subotica).

It may be a matter of poetic justice that the Magyars, who treated the idea of national rights (other than their own) with contumely, should have suffered most now that boundaries are made on nationalistic lines.

From the point of view of religious adherence, the new Hungary differs from the old kingdom. With the exception of the Protestants, mainly Calvinists, east of the Tisa, the bulk of the people are Roman Catholics. The Austria and Czecho-Slovakia sections are Roman Catholic. Rumania contains nearly all the Greek Orthodox of the old state; the rest are in Yugo-Slavia. There are Lutherans in Rumania; but half the area is Roman Catholic, as is more than half of Yugo-Slavia.

From the standpoint of communications two facts are important. Yugo-Slavia controls the lower Danube navigation; it definitely holds both banks of the Danube and also the junctions of the Drave, Save, and Tisa with the main stream. On the other hand, Hungary retains the greater portion of the railways; no part of the boundary is much more than 150 miles by rail from the capital; most of the main lines and nearly all the cross connections are within the new Hungary.

HUMAN GEOGRAPHY OF FRANCE: A REVIEW*

As Vidal de la Blache's well-known "Tableau de la géographie de la France" formed the introduction to Lavisse's great co-operative history of France, the work under review will constitute, when completed, the introduction to a new co-operative "Histoire de la Nation Française" now appearing under the editorial direction of Gabriel Hanotaux. This first volume of the "Géographie humaine de la France" is a large, imposing, clearly printed tome, full of diagrammatic maps and tasteful sketches in black and white and in color. Written in a free, discursive style, it fulfills—so far as it alone is concerned—the promise of Hanotaux in his introductory remarks to the series as a whole, that a departure was to be made from Germanic methods which encumber the reader with the mechanism of scholarship and overwhelm him with "the details of research and the chicanery of discussion." The reader is to be served only with the matured results of long, deliberate, and careful study of authorities in their respective fields. This is certainly true of Brunhes' book; it is a work characteristic of French scholarship. Couched in popular form, readable and inspiring to the novice in the subject, it is at the same time a profound and original contribution to scientific literature.

Americans have for some time been familiar with the "Human Geography" of Jean Brunhes; as its subtitle reads in the English translation, "an attempt at a positive classification; principles and examples." The new work is the logical application to a specified territory of the broad principles outlined in the "Human Geography," for the latter certainly made no claim to be more than an outline of method and was in no sense intended to pose as a complete manual of a vast subject. In both books we cannot fail to be struck by the author's broad scholarship, his command of the literature of geology, history, anthropology, and geography, his able mustering of a mass of detail, and, at the same time, his originality of thought and vivid picturesqueness of style. If now and then we are a little stupefied by his Gallic flights of rhetoric, we are delighted on nearly every page by the incisive turns of phrase expressing complex and difficult ideas, the neatness of which has justified us, we hope, in giving way in this review to a frequent temptation to quote.

Gabriel Hanotaux says that the historical point of view changes from generation to generation and that each successive generation must write its own history of France. This is also true of the geography of France (or of any other dynamic country, for that matter). To be convinced of this, let us but compare the learned compilations of facts given in the books of Malte-

* Jean Brunhes: Géographie humaine de la France, Vol. I (forming, with "Introduction Générale" (LXXX pp.), Tome I of Gabriel Hanotaux, edit.: Histoire de la Nation Française, 15 vols.). 495 pp.; maps, ills. Société de l' Histoire Nationale, Plon-Nourrit & Cie., Paris, 1920.

Brun and Elysée Reclus with the analytical volumes of Vidal de la Blache and Brunhes. But Brunhes does not reduplicate the work of his teacher, Vidal de la Blache, the great apostle of regional geography, the founder and inspirer of a new and vital French school. The pupil to a large extent abandons the strictly regional method, partly on principle, as we shall see, and partly because in doing so he is given a free field for the synthesis of many observations and ideas which a strict adherence to regional description would have made difficult, if not impossible.

The "Géographie humaine de la France" is divided into six parts of which only the first two fall into the present volume. The first part is entitled "General geography, the permanent framework and the human factor." By "permanent framework" is meant the geologic and physiographic structure of the country (*l'architecture du pays*), its climate, and its river courses, which may rightly be regarded as permanent and unchanging so far as man is concerned. But, while Brunhes devotes separate chapters to developing the subject of man's natural environment, he constantly keeps this environment in view when interpreting the facts of human geography. He remarks humorously: "Geology and morphological topography are not *hors d'œuvres* which geographers must treat in one or two chapters as a sop to their consciences." Though he stresses the idea that human geography is never static, but constantly changing, he considers that the type of people composing the French nation, as well as certain human institutions, have acquired a sort of relative permanency. Hence he includes also in the first part of his book chapters on the origins of the French population, and on place names, languages, and dialects.

The second part, entitled "First principles of regional geography," is a study of the various natural, human, and administrative regions into which France has been, is, and might be divided; of provinces and *pays*, regions characterized by divers forms of habitation, by various groupings of habitations in relation to each other; and (in the Epilogue) of ideal political and economic regions.

Political and economic geography in their wider scope, social and economic life, and demography are subjects reserved for the second volume.

Throughout the book Brunhes sounds a note of warning against all seductively simple explanations and deductions. An apparently obvious relationship will not seem so obvious, an a broad generalization will not seem so safe, when the facts are examined in detail and critically weighed. Many years ago Dufrenoy and Élie de Beaumont explained, in terms which have become almost classic in French geography, a supposed antithesis between the Massif Central and the Paris Basin. The Cantal, placed in the center of the Massif Central, they styled the *pole of repulsion* of France, away from which the rivers of nature and the streams of human life alike took their course as if repelled by the convex slope and general inhospitality of the ground. Paris, on the other hand, in the concave hollow of the Paris Basin, they termed the *pole of attraction*, the center of population and of

civilization towards which all things converge. In criticizing this pretty idea and other generalizations of the same ind, Brunhes makes a remark which we may well regard as the text of his entire work: "Truth," he says, "is more delicate than this, more subtly nouanced. Geology and physical geography certainly aid in explaining human geography and history, but they do not fatally determine them. One is almost tempted to recall an expression of Pascal and to say that the two latter sciences belong to a wholly different 'order' from the former."

In much the same spirit Brunhes attacks the "simplifiers" among the historians, who have conceived of the history of France as conditioned by a gigantic and continuous struggle between opposing races. "Human facts are more complicated than an oversimple archeology and history have often depicted them for us." He criticizes attempts made in the past to mark off by a sharp line on the map the boundary between the territories of the *langue d'oc* and the *langue d'œil* and explains how recent studies have shown that "the reality is much too complex to be expressed by a simple line of separation." A map is supplied to illustrate how in reality one dialect merges into the other.

The same underlying motive—which, perhaps, marks a reaction against that sometimes exaggerated love of logical classification and arrangement so characteristic of the French—led Brunhes to turn his back on the regional method of treatment. For many years after the middle of the eighteenth century French geographical thought was held captive by the theory that the hydrographic basins of rivers form veritable geographic units. Though this might be true in some cases, it was finally perceived that many river systems are entirely lacking in geographic homogeneity, as is notably the case with the Loire and the Rhine. Geographers then came to regard countries "as being constituted of divers *regions* which they wished violently to cut off one from the other." The importance of natural regions was, in Brunhes' opinion, exaggerated; and too much of the idea of watertight compartments entered into geographic description. In his own work he takes a middle course between those who overemphasized the importance of river systems and those who overemphasized the importance of regions. The rivers serve him as convenient connecting threads (*fils conducteurs*) for a preliminary and relatively brief regional description of the whole of France, introductory to the comparative studies that form the main part of the book.

Theorists, Brunhes complains, have been prone to urge a radical administrative reorganization of the nation into "regions" of their own devising. He was, however, ready to admit that the organization by *départements* leaves much to be desired and, in the Epilogue to the volume before us, suggests a governing principle that should be kept in view in any future subdivision of France. The great mistake in the past has been the advocacy of administrative regions of homogeneous character. "The region of the future ought not to be specialized in the narrow sense of the word but should be founded

on an adaptation to natural and human conditions which will—if we may be permitted a technical term of modern industrial economy—orient it towards *integration*." Diversity, rather than uniformity, will in the long run produce the greatest richness of provincial life both spiritual and material.

Brunhes' main contribution to human geography has been the study of the tangible and material modifications which man has made of the earth's surface by building houses, farms, roads, villages, cities. The study of the human habitation as a geographic element is being pursued more vigorously in France than elsewhere, probably on account of the great variety of habitation types that exist in that country. We may, perhaps, take exception to Brunhes' remark that of all the "essential facts by which man's activity is written upon the earth's skin" (*faits essentiels par lesquels l'activité des hommes s'inscrit sur l'epiderme terrestre*) the house is the most geographic and most characteristic. Certainly the same general type of habitation—house and barn—is found throughout the farming districts of the northern United States under widely varying conditions of physiographic environment and ethnic tradition. In Europe, on the other hand, with its infinite variety in the forms of habitation, Brunhes' words hold good. One may fall into the pitfall of over-easy generalization in dealing with habitations: one is often tempted to jump at the conclusion that the form of house, arrangement of stables, granges, outlying buildings, etc. are inevitably a direct result of the type of agriculture carried on and that this in its turn is the immediate result of the nature of the ground and of the climate. This is undeniably true in some parts of France: in Rouergue, for instance, there are three kinds of soil, three types of agriculture, and three types of habitation—all corresponding very neatly to one another. On the other hand, Brunhes shows us that in Flanders a sharp boundary line between two areas of different types of habitation is determined not at all by physiographic, but by ethnographic, differences on either side of the line. There are two distinct forms of roof construction in France, steep roofs and flat roofs: the steep roofs have been said to be characteristic of the rainy climate of the north; the flat roofs of the dry climate of the south. Brunhes has tested the application of this statement by drawing a map of the roof forms throughout the country. This shows that, whereas in a very general way flat roofs prevail in the south and are characteristic of Mediterranean conditions, and steep roofs prevail in the north, there are many exceptions to the rule. Large areas in the southern Massif Central have steep roofs, and there is a great island of flat-roof country between Châlons-sur-Marne and Épinal. The details of this distribution, he concludes, have been determined entirely by historical causes and do not in any way reflect local climatic or physiographic conditions.

THE FIFTH JOINT MEETING OF THE AMERICAN GEOGRAPHICAL SOCIETY AND THE ASSOCIATION OF AMERICAN GEOGRAPHERS

The fifth joint meeting of the Association of American Geographers and the American Geographical Society was held at the Society's house, Broadway at 156th Street, New York, on April 22 and 23. Mr. John Greenough, President of the Society, welcomed the members of the Association, and Miss Ellen Churchill Semple, President of the Association, presided. The program follows:

Friday Morning Session

William L. Westermann: The Treaty of Sèvres.

Nevin M. Fenneman: Certain Human and Economic Problems Growing Out of Physical Conditions in Africa.

Homer L. Shantz: New Vegetation and Land Classification Maps of Africa.

Curtis F. Marbut: A Proposed Soil Map of Africa.

Friday Afternoon Session

Alan G. Ogilvie: Distribution Studies in Relation to the Millionth Map of Hispanic America.

George M. McBride: Geographical Aspects of Land Tenure Systems in Mexico.

M. Aurousseau: The Distribution of Population—A Constructive Problem.

Friday Evening

Round Table Discussion of Geographical Research led by

F. E. St. Austell, Continental and Commercial National Bank, Chicago.

H. P. Vose, Research Department, American International Corporation, New York City.

Archer W. Douglas, Simmons Hardware Company, St. Louis.

H. H. Barrows, University of Chicago.

Saturday Morning Session

Henry S. Graves: Our Critical Forest Problems.

Frank A. Waugh: Diversity of Forest Utility.

The Society entertained the Association at dinner on Thursday and Friday night and at luncheon on Friday and Saturday. On Thursday night following the dinner there was an informal conference on "Geography in Higher Institutions of Learning," led by Professor Edward B. Mathews, Chairman of the Division of Geology and Geography, National Research Council.

Under the title of "Geology and Geography in the United States" Professor Mathews' paper (with Homer P. Little as junior author) is published in a preliminary edition in the Bulletin of the Geological Society of America, Vol. 32, 1921, pp. 1–22, Reprint and Circular Series of the National Research Council. It is a paper of more than passing importance in the development of the educational side of these two subjects. In a summary of the paper are the five following conclusions of geographical interest:

"The opportunities for training in geography are inadequate to supply the specialists demanded. In our educational system there is also an unfortunate break in continuity of instruction in the subject in high schools and colleges, so that few become acquainted with its possibilities as a vocation.

"The present lack of collegiate instruction prevents the presentation of the professional possibilities of geography and deprives students of a general training especially helpful in many fields of activity.

"The productivity of the relatively few specialists in geography is great, covering a wide range of subjects, without very clear definition of the limits of geography toward other subjects, either as to method or matter.

"Closer characterization in this respect would help administrative educators to understand the advantages accruing from the establishment of courses in collegiate and university geography and their proper departmental association.

"Research in geography is largely unorganized and individual, except in the field of exploratory expeditions."

Both the program and the discussions were even more interesting and valuable than on preceding occasions. Of the papers mentioned in the program, that by Mr. Aurousseau will be published in the October number of the *Review;* those by Messrs. Marbut and Shantz will form part of a descriptive pamphlet to be published with maps of the soils and vegetation of Africa under the joint auspices of the National Research Council and the American Geographical Society; Mr. McBride's paper will form a number in the Research Series of the Society; and Mr. Ogilvie's paper dealt with matters relating to the millionth maps and accompanying handbooks announced in an earlier number of the *Review.*

Professor Westermann's spirited paper dealt with the historical setting of the treaty of Sèvres; Dr. Graves' paper presented the state of forests and forest problems in their geographical relationships; and Mr. Waugh's paper gave a general view of the character, use, and value of the forest reserves of the United States.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Presentation of the Cullum Geographical Medal to His Serene Highness Albert I, Prince of Monaco. At the monthly meeting of the American Geographical Society on April 23, 1921, at the Engineering Societies' Building, 29 West Thirty-ninth Street, the Cullum Medal of the Society was presented to His Serene Highness Albert I, Prince of Monaco. In presenting the medal, President Greenough, who presided at the meeting, spoke as follows:

"The present occasion is in some respects unique in the long history of the Society. Our royal guest has divested himself, for the time being, of his prerogative as Sovereign, and desires to be met here solely on the universal platform of scientific research and attainment. Therefore, in awarding him the medal, which as your President, I am about to present, the short inscription upon it was framed in simple phrase as follows:

To Albert I, Prince of Monaco
1921

By intensive exploration and by research and publications of the highest order he has advanced the science of oceanography and extended man's knowledge of the sea and its resources.

"It is difficult to summarize briefly the methods and results which have distinguished the labors of our guest during a period now exceeding a quarter of a century. In every department of oceanography he has been the leading exponent, and he has provided an establishment for the preservation and continuance of his life work by the building in Paris and Monaco of two beautiful structures to serve as a museum for his collections, and as a laboratory for his permanent staff. This Oceanographic Institution, as it is named, has been adequately endowed by him, and under his supervision directs the forces in vessels, equipment, plans, and personnel requisite for his investigations.

"His yacht, *The Princess Alice*, has periodically traversed the ocean, mapping the configuration of its floor, measuring its currents, and revealing the mysteries of the life and condition of its denizens, employing in all these researches many new and ingenious instruments and devices. Likewise, valuable meteorological studies have been conducted of great interest and practical value to navigators.

"It is not possible at this time to enumerate all his varied contributions to scientific learning, which embrace not only the surface of the waters, but likewise, the elements above and below them. Suffice it to say that the institution which he has founded stands the chief of its kind in the world.

"And now, Sir, on behalf of the American Geographical Society, I beg that you will receive this memorial of its appreciation of your long continued service to the science to which we are mutually devoted. It will be a lasting source of pride to the Society that our insignia have been accepted by one who has contributed so notably, alike by his own achievements, by the distinction of his personality, and by the incentive of his example."

After receiving the medal and expressing his appreciation of it His Highness outlined the beginnings of his work in oceanography and the development of his great oceanographic museum. His talk was illustrated with still and moving pictures representing almost all phases of the actual field work necessary to gather the types on exhibition at the museum. On the geographical side there was discussed both the methods and the results of soundings of the sea and the air. An informal reception followed the lecture.

Elections to Fellowship. At the April meeting of the Society, President Greenough presiding, there were presented with the approval of the Council the names of 266 candidates who were duly elected as Fellows of the Society.

Presentation of the Livingstone Medal to William Speirs Bruce. The presentation of the Livingstone Medal to William Speirs Bruce took place at the monthly meeting of

the Royal Geographical Society in London on December 20, 1920, the occasion being felicitiously chosen to precede a discussion on the "*Future of Polar Exploration.*"

Introducing Ambassador John William Davis, by whom the presentation was made, President Lieutenant-Colonel Sir Francis Younghusband said:

"The American Geographical Society of New York have awarded their Livingstone Medal to Dr. Bruce, the great Antarctic explorer. Dr. Bruce unfortunately is not able to be present here this evening on account of ill health, but Dr. Rudmose Brown is here to receive the medal on his behalf, and His Excellency, the American Ambassador, has honored us with his presence this evening; he will, on behalf of the American Geographical Society of New York, present the medal to Dr. Rudmose Brown. At a meeting when we are going to discuss both the past and the future Polar exploration we thought it a specially favorable opportunity for this ceremony. I will now ask His Excellency to present the medal."

In presenting the medal Ambassador Davis said:

"I have in my possession, as the President has told you, the David Livingstone Centenary Medal which was founded by the Hispanic Society of New York on the occasion of the one-hundredth anniversary of the birth of David Livingstone and is to be awarded by the American Geographical Society, for whom I speak, for scientific achievement in the field of geography in the southern hemisphere. It is my very great pleasure, on behalf of the American Geographical Society of New York, to deliver that medal tonight to the representative of the distinguished scientist and explorer whom they have chosen as its recipient. To this gathering, of course, I need say nothing in vindication of their selection, nor can I fail to express my own gratification that no narrow confines have limited their search for a person worthy to receive the medal and that they have found such a recipient in the British Isles. To give even a catalogue of all Dr. Bruce's achievements in the field of geographic exploration would be beyond either my powers or your patience, but since the medal is directed solely to exploration in the southern hemisphere, it is well to recount that in 1892–1893 Dr. Bruce was the naturalist of the Scottish Antarctic expedition, in 1896–1897 he was the leader of the Jackson-Harmsworth Polar expedition, in 1902–1904 he was the leader of the Scottish National Antarctic expedition. He was the discoverer of the 150 miles of the coast line of the Antarctic, named by him Coats Land, and has bathymetrically surveyed great areas of the South Atlantic Ocean and the Weddell Sea. He was for many years the Director of the Scottish Oceanographical Laboratory of Edinburgh, is an LL.D. of Aberdeen University, and a Fellow of the Royal Society of Edinburgh, and I feel for myself that it is not only a pleasure but an honor to deliver this tribute to so distinguished a scientist from his brothers in science across the sea."

The Ambassador thereupon presented the medal, in the acceptance of which on behalf of Dr. Bruce, Dr. Rudmose Brown spoke as follows:

"Your Excellency, I am asked by Dr. Bruce to thank the American Geographical Society for the high honor that it has conferred upon him, and you personally, Sir, for your kindness in coming here to deliver the medal. Dr. Bruce wishes me to assure you that he considers it a very high honor indeed that his work should be recognized by the countrymen of such great explorers as Wilkes, De Long, Greely, Peary, and others. I will convey this medal to Dr. Bruce, and your kind words, Sir, in presenting it."

Mr. Joerg's Mission. Mr. W. L. G. Joerg, Editor of the Research Series of the Society, sailed from New York on May 21 for a six months' journey in western and central Europe. He will investigate the status and tendencies of geographical work in learned societies and in universities and colleges; and in addition he expects to attend the meeting of the geographical section of the British Association for the Advancement of Science at Edinburgh from September 7 to 14, and to be the Society's representative at the centennial celebration of the Geographical Society of Paris from July 4 to 7. Communications to him may be addressed in care of Brown, Shipley & Company, 123 Pall Mall, London, S. W.

NORTH AMERICA

Great Cities of the United States, 1920. The 1920 census of the United States shows 64 cities with a population over 100,000. This includes single cities and group cities. The group cities (starred * in Table I and listed by components in Table II) are those that

make up one city mass of continuous extent, without regard to political control, even though it cross state boundaries (as at New York), international boundaries (as at Detroit), or deep water (as in both those cases), for deep water, when well supplied either with ferries or bridges, connects its shores in a most intimate way.

TABLE I—POPULATION OF CITIES OF OVER 100,000 PERSONS

1	New York*	6,657,447	34	Birmingham, Ala.	178,806
2	Chicago	2,701,705	35	Syracuse, N. Y.	171,717
3	Philadelphia*	1,952,250	36	Richmond, Va.	171,667
4	Detroit *	1,118,137	37	Norfolk, Va.*	170,164
5	Boston*	1,071,897	38	New Haven, Conn.	162,537
6	St. Louis, Mo.*	839,664	39	Memphis, Tenn.	162,351
7	Cleveland, O.	796,841	40	San Antonio, Tex.	161,379
8	Baltimore, Md.	733,826	41	Dallas, Tex.	158,976
9	Pittsburgh, Pa.*	681,412	42	Dayton, O.	152,559
10	Los Angeles, Cal.	576,673	43	Bridgeport, Conn.	143,555
11	Buffalo, N. Y.*	524,693	44	Duluth, Wis.*	138,588
12	Cincinnati, O.*	512,651	45	Houston, Tex.	138,276
13	San Francisco, Cal.	506,676	46	Hartford, Conn.	138,036
14	Milwaukee, Wis.	457,147	47	Scranton, Pa.	137,783
15	Washington, D. C.	437,571	48	Grand Rapids, Mich.	137,634
16	Kansas City, Kan. Mo.*	425,587	49	Paterson, N. J.	135,875
17	New Orleans, La.	387,219	50	Youngstown, O.	132,358
18	Minneapolis, Minn.	380,582	51	Springfield, Mass.	129,614
19	Oakland, Cal.*	317,946	52	Des Moines, Ia.	126,468
20	Seattle, Wash.	315,312	53	New Bedford, Mass.	121,217
21	Indianapolis, Ind.	314,194	54	Fall River, Mass.	120,485
22	Rochester, N. Y.	295,750	55	Trenton, N. J.	119,289
23	Portland, Ore.	258,288	56	Nashville, Tenn.	118,342
24	Denver, Colo.	256,491	57	Salt Lake City, Utah	118,110
25	Louisville, Ky.*	244,989	58	Albany, N. Y.	113,344
26	Toledo, O.	243,164	59	Lowell, Mass.	112,759
27	Providence, R. I.	237,595	60	Wilmington, Del.	110,168
28	Columbus, O.	237,031	61	Reading, Pa.	107,784
29	St. Paul, Minn.	234,698	62	Fort Worth, Tex.	106,482
30	Omaha, Neb.*	227,763	63	Spokane, Wash.	104,437
31	Akron, O.	208,435	64	Yonkers, N. Y.	100,176
32	Atlanta, Ga.	200,616		Lynn, Mass.	99,148
33	Worcester, Mass.	179,754		Tacoma, Wash.	96,965

The group cities are realities, but the census recognizes them only when they have been politically united, as Brooklyn and New York have been since 1898. Brooklyn was geographically a part of New York long before the city governments were "consolidated;" and Jersey City is today a part of New York—a fact more difficult to confirm politically.

The criterion used in selecting the adjacent towns to be included with a city is continuity of close, city-like occupation of the ground on land areas, which includes park spaces, properly a part of a city to maintain the health of its citizens, but does not include farm lands and meadows that may be included within the political city area, as in Queens Borough, New York. The group city so conceived is a more real city than the Metropolitan Districts of the Census Bureau, which include all population centers of 5,000 people within 10 miles of the city limits. No one who looks over the actual ground between New York and Paterson, whether he travels by train or road, can say that Paterson, N. J., is part of one continuous city with New York. There are doubtless many ties between the two towns that a little inquiry would bring out, but their separateness leaps to the eye. This is not equally true of Newark, for there is nothing between it and New York but water channels and marshes that may conceivably be dredged out or built up to form an expansion of the actual port of New York. Navigable water at a great seaport ties opposite shores most intimately. The proper selection of adjacent places to be included calls for local

FIG. 1—Great cities of the United States (100,000 population and over) according to the 1920 census. Canadian cities have been added according to the 1911 census. Note distribution in regard to elevation as shown by the addition of the 1,000-foot contour line.

knowledge. Probably other places than those listed as group cities should be so regarded. The compiler of this list would be glad to have information on this head. Should St. Paul and Minneapolis be regarded as one?

TABLE II—COMPONENTS OF GROUP CITIES LISTED IN TABLE I

1	New York	5,620,048
	Newark, N. J.	414,524
	Jersey City, N. J.	298,103
	Elizabeth, N. J.	95,783
	Bayonne, N. J.	76,754
	Hoboken, N. J.	68,166
	West Hoboken, N. J.	40,074
	North Bergen, N. J.	23,344
	Union, N. J.	20,651
		6,657,447
3	Philadelphia, Pa.	1,823,779
	Camden, N. J.	116,309
	Gloucester City, N. J.	12,162
		1,952,250
4	Detroit, Mich.	993,678
	Hamtramck	48,615
	Highland Park	46,499
	Windsor, Ont. (estimate)	29,345
		1,118,137
5	Boston, Mass.	748,060
	Cambridge	109,694
	Somerville	93,091
	Chelsea	43,184
	Everett	40,120
	Brookline	37,748
		1,071,897
6	St. Louis, Mo.	772,897
	East St. Louis, Ill.	66,767
		839,664
9	Pittsburgh, Pa.	588,343
	Wilkinsburg	24,403
	Homestead	20,452
	McKees Rocks	16,713
	Sharpsburg	8,921
	Bellevue	8,198
	Millvale	8,031
	Edgewood	3,181
	Aspinwall	3,170
		681,412
11	Buffalo	506,775
	Lackawanna	17,918
		524,693
12	Cincinnati, O.	401,247
	Covington, Ky.	57,121
	Newport, Ky.	29,317
	Norwood, O.	24,966
		512,651
16	Kansas City, Mo.	324,410
	Kansas City, Kan.	101,177
		425,587
19	Oakland, Cal.	216,261
	Berkeley	56,036
	Alameda	28,806
	Richmond	16,843
		317,946
25	Louisville, Ky.	234,891
	Jeffersonville, Ind.	10,098
		244,989
30	Omaha, Neb.	191,601
	Council Bluffs, Ia.	36,162
		227,763
37	Norfolk, Va.	115,777
	Portsmouth	54,387
		170,164
43	Duluth, Minn.	98,917
	Superior, Wis.	39,671
		138,588

On the map have been added the only great cities of Canada according to the census of 1911—Montreal 470,480, Toronto 376,538, Winnipeg 136,035, Vancouver 100,401 (estimates for 1919 give: Montreal 670,000, Toronto 489,681, Winnipeg 183,595, Hamilton, Ont. 110,137, Quebec 110,000, Vancouver 109,250, Ottawa 104,000). The 1,000-foot

contour line is also added. It shows strikingly how the cities are distributed over the lower lands and the passages afforded by river valleys. Of course effective communication in these days is always by rail beside the river.

MARK JEFFERSON

The Topographical Map of the United States. The mapping of our country may be said to have been in progress since the time Captain John Smith made a chart of Chesapeake Bay, but after three hundred years only forty per cent of our area has been topographically mapped and of this forty per cent a large part needed to be re-surveyed because of the improvement in methods and the greater accuracy demanded by the map users. It is safe to say that only between twenty-five and thirty per cent of the area of the United States has been adequately surveyed and mapped topographically.

Yet in various scientific, industrial and commercial undertakings the topographical map is a fundamental. No one would expect to have accurate geological surveys made in an area over which topographical surveyors have not previously operated; nor would one expect an engineer to construct a dam for the storage of water for either irrigation or power development without a topographical survey of the drainage basin. The highway engineers of the country need topographical maps in order to lay out their system of principal roads with a view of getting the most feasible route between centers of population and to provide low grades along the road. The forester needs to know the configuration of the forest area in the proper utilization of forest products. The stockman desires to know the slope of the ground in planning grazing operations. The prospective farmers need to know the configuration of the territory within which they expect to settle. Cases are known to the writer where farms have been selected without a visit from the purchaser when he had a topographical map covering the area and a report of the Bureau of Soils. Not the least of the uses of a topographical map are connected with defense. Its significance in military operations has been amply shown by the experience of the armies in Europe during the Great War.

The United States has vast natural resources in the form of minerals, including coal and iron, water power, lands that may be irrigated and drained, forest productions, etc., but we do not know just what we have in the way of resources nor do we know whether in all cases we can utilize those whose existence is known. In order to discover what we have and to utilize and conserve our resources we need the topographical map as a basis of our information and activities.

A special interest therefore is attached to the bill introduced in the House of Representatives on April 26, 1921, by Congressman Temple of Pennsylvania, providing for the completion of the topographical survey of the United States.

The bill if passed will authorize the president to complete, within a period of twenty years from the date of the passage of the act, a general utility topographical survey of the territory of the United States, including adequate horizontal and vertical control. The bill also provides for the preparation and publication of the resulting maps and data. The president would be authorized to utilize the services of such agency or agencies of the government as now exist or may hereafter be created and to allot funds to them from the appropriations made from time to time to carry out the purposes of the act. The bill also provides that co-operative agreements may be made between the agencies of the government carrying on the topographical surveying with any state or subdivision thereof. It is hoped that early hearings will be held by a Committee of Congress on this most important measure.

WILLIAM BOWIE

SOUTH AMERICA

General Rondon's Work in the Brazilian Wilderness. The April number of *France-Amérique* contains an appreciation by General Gamelin of General Rondon's work (Le Général Rondon et ses explorations au Brésil, pp. 81–87).

From his own country where his exploits have surrounded him with a halo as that of the legendary hero General Rondon's fame has traveled afield. Fellows of the American Geographical Society will recall the review of his achievements made by Colonel Roosevelt on the occasion of the presentation to General (then Colonel) Rondon of the David Livingstone Medal of the Society (*Geogr. Rev.*, Vol. 5, 1918, pp. 496–497). A native of Cuyabá, capital of Matto Grosso, Rondon has spent some thirty years of his life in the *sertão* of this

vast state. His explorations, made in the service of the Brazilian Telegraphic Commission, have covered a block of territory lying between the parallels 3° and 22° S. latitude and the meridians 50° and 65° W. of Greenwich. This great region is not infrequently known as Rondonia following the term of Professor Róquette-Pinto in his anthropological-ethnological study "Rondonia" (*Archivos do Museu Nacional do Rio de Janeiro*, Vol. 20, 1917).

The most concrete result of Rondon's work is the telegraphic link between the waters of the Paraguay and the Amazon across the heart of the continent. It comprehends 4,500 kilometers of line, to which correspond paths 5 to 10 meters broad cut in part through tropical forest and in places paralleled by roads practicable for automobiles, and dotted by nuclei of native populations where nomadic savages are being initiated into ways of settled life. The work has been carried out in a series of stages. The years from 1890 to 1898 were spent in construction of the line from Goyaz to Cuyabá, whereby this erstwhile isolated town was brought into touch with the rest of the country. From 1900 to 1904 the line was extended to Corumbá, the port of Cuyabá on the Paraguay. Here with the success that has peculiarly stamped his dealings with primitive peoples Rondon pressed into his service members of the intractable Bororo tribes. From 1905 to 1906 lines were laid in the south of the state along the Bolivian and Paraguayan frontiers. In 1907 Rondon embarked on the most important stage of his work as regards geographical results—that in the northwest for the installation of the line to Santo Antonio de Madeira. From this date to 1915 with his assistants he carried out the series of explorations of the Amazonian tributaries that take their source in the Matto Grosso uplands. It was on one of these that he was accompanied by Colonel Roosevelt in the journey that changed the "Rio de Duvida" to "Rio Theodoro" (Colonel Roosevelt's Exploration of a Tributary of the Madeira, *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 512–519). Here may be noted the recent decision of the Geographical Society of Rio de Janeiro to change the river name to "Rio Roosevelt." From 1915 to 1919 Rondon remained in Upper Matto Grosso and Amazonia completing his geographical work the results of which appear in the series of publications by the Commissão de Linhas Telegraphicas Estrategicas de Matto-Grosso ao Amazonas.

EUROPE

Upper Silesia: An Essay in Geographical Description. Under the title "Oberschlesien" Professor Bruno Dietrich of Breslau makes a contribution to a forthcoming volume of geographical sketches by pupils of Professor Hettner of Heidelberg (Zwölf länderkundliche Aufsätze von Schülern Alfred Hettner's ihrem Lehrer zum 60. Geburtstag, Breslau, 1921, pp. 63–80).

Upper Silesia, the terminal part of a political peninsula of Prussia projecting southeastward up the Oder drainage area between what used to be Austria and Russia but is now Czecho-Slovakia and Poland, is of special interest today on account of the political situation.

Dietrich's description of the natural subdivisions is informing but somewhat difficult to understand because of the repeated use of unimportant town names. The accompanying outline map is too crude to lessen this defect to any extent. In this note Dietrich's provincial method is replaced by a self-explanatory form of statement whose intelligibility may be tested by the reader's success in drawing or imagining an outline map as the successive specifications are followed.

The province of Upper Silesia is a quadrilateral of irregularly sinuous boundary, measuring 100 kilometers on the southwestern side, 120 kilometers on the northwestern, 140 kilometers on the northeastern, and 80 on the southern. It is for the most part underlain by horizontal indurated strata, much dislocated by block faulting; but the initially uneven surface thus produced is almost extinguished by post-faulting degradation, by a partial unconformable cover of less indurated strata, and by widespread unconsolidated deposits of glacial drift and loess. The resulting upland surface, from 200 to 300 meters in altitude, is for the most part of low relief, being a small section of the great plain of central Europe. The areas of sandy drift are generally wooded; the loess-covered areas are farmed. The upland is traversed a little west of its center by a 100-kilometer stretch of the moderately sinuous Oder valley, trending north-northwest, 6 kilometers wide at its upstream (southeastern) entrance and 12 kilometers wide at its downstream exit, with the towns of Ratibor near its upper end, Cosel above its middle, and the important city of Oppeln near its lower end. The province is thus divided into a smaller southwestern isosceles triangle and a larger northeastern rectangle, both of indented sides. The smaller or triangular area is truncated at

its end, where it is 12 kilometers wide upstream; it widens to 60 kilometers at its downstream end and rises gradually to the foothills of the Sudeten on its southwestern side, near the middle of which a small salient of Czecho-Slovakia penetrates the triangle for 20 kilometers. This area is mostly agricultural, with Neisse in the northwest and Neustadt and Leobschütz on either side of the Bohemian salient as its chief towns; but a 40-kilometer segment of its northern angle is largely woodland, with Falkenberg near its center.

The larger rectangular area northeast of the Oder valley is 140 kilometers in length on its strongly indented northeastern side and 50 or 60 kilometers in width. A rich, loess-covered farming district 10 or 20 kilometers wide, of somewhat hilly surface, crosses its southern end where the ascent to the Beskiden ridges of the Carpathians begins; there Rybnik to the west and Pless to the east are the chief towns, and a long segment of the northern angle is occupied by a less fertile farming district which stretches 90 kilometers from the middle of its northeastern to the middle of its northwestern side; here Kreuzburg to the northwest, Rosenberg near the middle, and Lublinitz to the southeast are the chief towns. The rest and greatest part of the rectangle is chiefly woodland without large towns; but there are two important districts of other character. One of these is a higher upland belt, known as the Chelm, determined by an uplifted block of horizontal limestones, which modestly surmounts the rest of the region. It has a width of 10 to 20 kilometers and a length of 80 kilometers, trending east and west and therefore running obliquely across the middle of the rectangle from the Oder valley between Oppeln and Cosel nearly to the eastern border of the province and thus separating the great woodland area into a northern and a southern part. Forests prevail along the northern side of the belt where sandy drift is largely present; cultivated areas are found along the southern side where loess is abundant. The limestones of the Chelm contain ores of iron, zinc, and lead, as is further noted below; the ores are mined mostly near the eastern end of the belt, where Tarnowitz is the chief town.

Much more important than any other is a semicircular district next south of the Chelm, with its limiting diameter of 40 kilometers on the eastern border of the province; in this half circle—part of a larger area that continues east and south into Poland—deformed and degraded coal-bearing rocks reach the surface and determine a remarkable concentration of industries. Here are the richest coal reserves in Europe, and here mining, smelting, and manufacturing flourish, especially in the Prussian part of the coal-bearing area; for, although the international boundary cuts the coal field about in half, nearly 71 per cent of its product in 1911, or about 40,000,000 tons, came from Prussian mines, and this constituted 23 per cent of the coal mined in all Germany. Zinc and lead ores from the Chelm limestones are smelted here and supply 63 per cent and 20 per cent of the German product of these metals. Iron production is also important, although it is small compared with that of the Rhine province; but, as fuel for smelting is abundant, iron ore from the Chelm is largely supplemented by imported ore.

With the development of the mineral resources of this district, cattle and wood, which were the chief products of the province in earlier centuries, now have a relatively low rank; primitive iron smelting with charcoal, which used to be carried on in the woodland district north of the Chelm, is abandoned; and the small semicircular industrial district, formerly not populated more densely than the rest of the province, now has about 700,000 inhabitants, or a third of the total. Some of the industrial centers increased three or four fold in the 40 years following 1871. A network of railroads now connects many towns of large size, the chief being Königshütte, Beuthen, Gleiwitz, Zaborze, and Kattowitz; the landscape is characterized by shaft houses and furnace chimneys; the use of timber in the mines is causing serious encroachments upon the neighboring woodlands. Little wonder that the threatened loss of a province which includes so rich a district as this is dreaded by Germany; while the gain of the province by Poland would make a magnificent addition to her already great economic resources.

Dietrich's final remarks on the population of Upper Silesia are of interest, though their interpretation is open to question. As a borderland not defined by physiographic barriers, the people have been of mixed origin for centuries past. Since the time of Frederick the Great, when Silesia was Prussia's share of booty in the partition of Poland, Upper Silesia has been the southeastern outpost of Hohenzollern conquest and domination. In 1910 the German-speaking population was 884,000, and the Polish, 1,169,000; with less than 10 per cent of the total speaking other languages. But, of the Polish-speaking majority, Dietrich claims that many speak "Wasserpolnisch" and that these are really Germans who have acquired a local dialect of the prevalent language; also that even the Upper Silesian

Polish-speaking inhabitants consider themselves Silesians, and not Poles living in Silesia; and that the present movement in favor of junction with Poland does not represent the wishes of these inhabitants but results from a propaganda conducted from beyond the boundary.

On the other hand, a less prejudiced view may be found in the chapter on Poland by the junior author of Haskins and Lord's recent book, "Some Problems of the Peace Conference" (Cambridge, Mass., 1920). After asking: "Since the rise of Prussia was accomplished mainly by the spoliation of Poland, could any one hope to effect a genuine restoration of Poland without taking a great deal of land away from Prussia?" Lord adds that the Prussian official language statistics in Silesia and other provinces formerly Polish "have been demonstrated by the most painstaking and detailed investigations" to be "grossly inaccurate" and "in fact deliberately falsified for the purpose of making it appear that Prussia's Germanizing policy in her 'Eastern Marches' has been more successful than is actually the case." This is partly proved by the Prussian school census of former Polish territory, which shows Poles to be from 50 to 100 per cent more numerous than they are represented in the general census.

The abundance of mineral deposits in the semicircular district of southeastern Upper Silesia, unknown at the time of the partition of Poland, and the resulting great development of industries through the nineteenth century have greatly increased the intensity of feeling with regard to the possible readjustment of international boundaries. Thus the truly geographical factor of natural resources has a dominant share in determining economic and historical problems.

W. M. Davis

The Cartographical History of Lower Austria. The *Monatsblatt des Vereines für Landeskunde von Niederösterreich* issues its July-September number of 1918 as a testimonial to Dr. Oswald Redlich on his sixtieth birthday. Herein appears an article by Dr. Eugen Oberhummer on "Die Entstehung des Kartenbildes von Niederösterreich," brief but pointed, and written in the scholarly and scientific vein so characteristic of all that has appeared from the pen of that distinguished Austrian geographer.

The first attempts to give place on the map to the region of Lower Austria, it is noted, had an early date. One could not expect to find it laid down on the small world maps of the Greeks, such as were those of Anaximander or of Eratosthenes; but in the monumental portico map of Agrippa, one time minister of Augustus, we find a work overtopping any corresponding previous effort, and in this the provinces of Rhaetia, Noricum, and Pannonia appeared. How he had represented the Danube region we may judge from such maps as the Peutingerian table and the Ptolemy maps drawn a century and a half later, in which there does not appear to have been great improvement.

Dr. Oberhummer, in agreement with that greatest living authority on the geography of Ptolemy, Professor Joseph Fischer, believing that we have in the recently found Codex Vaticanus Urbinus 82 the real or excellent copies of the first Ptolemy maps, notes that this manuscript contains a map of the Danube region.

One would scarcely expect to find on the cloister maps of the middle ages any attempt at an accurate representation of Lower Austria, or of any other region; and yet on the Ebstorf map of the late thirteenth century we find the Danube with certain tributaries represented and the names Wena, Austria, Crenesa, Starkenberch, and others—the first time the names Vienna and Austria appear on a map.

The accuracy of coast representations as we find them on portolan charts is properly noted, as is also the fact that there followed soon after their appearance the attempt to give a corresponding accuracy to the representation of interior regions. The author refers to the improvement in this respect to be observed in the charts of Angelino Dalorto of 1325 and 1329 and in the Catalan map of 1375.

In the map of middle Europe by Nicolaus Cusanus of 1450, but known in later editions only, and in the map of Germany as given in the Nuremberg Chronicle we find the Danube region coming more and more into prominence. We further note, about this time, a sort of attempt to combine the Roman road-map idea and the ordinary land map, an example of which we have in the "Carta itineraria Europae" of Waldseemüller.

Special independent maps of individual regions came into existence in Germany in the sixteenth century, the first of them being the Johannes Stabius map of the crownlands of Austria as they were in 1508, while in the year 1545 appeared Wolfgang Lazius' map of

Neiderösterreich, that is the entire Grand Duchy of Austria. His was the pattern map for all those issued of the region until the appearance of the Matthias Vischer map of 1670.

The author makes mention of the remarkably fine military map of the Hapsburg Empire begun by the order of Maria Theresa, but not completed before 1783, and now belonging to the department of the royal military archives. He concludes with a reference to the special map of Austria prepared between the years 1873 and 1880, and to the "administrative" map of Lower Austria, the issue of which was undertaken by the Verein für Landeskunde but awaits completion.

E. L. Stevenson

AFRICA

Kufra: A Prosperous Desert Settlement in Northern Africa. The eleven oases of Kufra, described by Ettore Ceriani in *L'Africa Italiana* (Vol. 39, 1920, No. 3), constitute one of the still imperfectly known human settlements of the Libyan interior.

Since the journey of Gerhard Rohlfs in 1879 only three Europeans have visited Kufra. Involuntary journeys were made by an Italian soldier who was held captive from 1914 to 1917 and by a French officer who a year later was detained in Kufra for some months (*L'Afrique Française, Renseign. Colon*, April, 1920, pp. 82–88). A few months ago a remarkably successful journey was accomplished by an Englishwoman, Mrs. Rosita Forbes whose route was from Benghazi to Kufra and via Siwa to Alexandria (*Nature*, May 19, 1921, pp. 366-367).

Kufra has changed from the rude village described byRohlfs to the proportions of a fairly organized small town. Its inhabitants, numbering some 10,000 according to estimates, are drawn from various sections of Mohammedan Africa and betray by their racial diversity the importance of the site as a commercial and religious center. The site is favored by an ample underground water supply which holds the first place among its natural advantages. Its climate, characterized by infrequent rainfalls and a subtropical average range of temperature, is not subject to such excessive changes of temperature as occur in other North African localities.

The modern prosperity of Kufra dates from the time of its selection as headquarters of the famous Senussi order. A fertile soil and the importance of the site at the junction of caravan routes connecting the Mediterranean coast with the sparsely populated hinterlands of northern Africa determined the choice. A feature of interest which characterizes the social organization of the Kufra community is found in the system of highly divided land tenure which prevails in the area. The relative importance of Kufra over other oases of the desert lands of northern Africa is thereby explained. It is a factor which, coupled to a relatively fertile soil, has made for the prosperity of the settlements. Practically every resident operates a farm, however small. Ownership of the soil is vested in the Senussi fraternity in the majority of instances, land being rented in small lots so as to satisfy the entire community.

Caravan traffic likewise brought its contribution to the prosperity of the settlement. An idea of the importance of this traffic may be gathered from the fact that for the second half of 1919 the value of goods passing through Kufra and routed to Cyrenaica alone amounted to over 2,000,000 lire. The traffic, however, was larger in former days, when caravans consisting of hundreds of men and camels would halt for several days at Kufra, there to renew supplies and to refit themselves for the remainder of the journey. In recent years, however, the caravan transit has been directed to Egypt, owing to the proximity of the oases within Egyptian boundaries. This innovation has led to an import trade by way of Egyptian caravan roads, which to the Italian colonial authorities appears as undesirable competition to the routing of goods via Libyan ports and roads. It appears that not infrequently Italian goods reach Kufra by way of Alexandria.

From the shores of the Mediterranean three main routes, starting respectively from Jedabia, Siwa, and Dakhla lead to Kufra. From Jedabia the journey lasts about seventeen days, travel consuming a daily average of twelve hours and being mostly accomplished at night. Over these roads caravans plow their way laboriously through a desert of deep sands and dunes. Twice only during the journey is water encountered.

In addition to the Mediterranean roads there are caravan routes linking Kufra with the Sudan, Wadai, and Tibesti. Over all these roads a constant, one might almost say daily, traffic reaches the great Senussi center.

Leon Dominian

ASIA

Medieval Origins of the Armenian Question. The first number of the new *Revue des Études Arméniennes* (Vol. 1, 1920, Paris) contains a scholarly study by J. Laurent (Professor at the University of Nancy) on "The Medieval Origins of the Armenian Question." M. Laurent first defines the term "Armenia." It has been applied to widely separated territories. "Great Armenia" has almost universally been used from classical times to designate the rough, mountainous tract between the headwaters of the Euphrates and the Araxes. This is a geographical expression. On the other hand the region called "Little Armenia," a political expression, has moved about in the course of history. In Greek and Roman times it embraced the upper valleys of the Lycus, Halys, and Euphrates; but during the middle ages it was shifted south to the shores of the Mediterranean.

Whatever her situation as a political entity, Armenia has always formed a disputed frontier zone between relatively powerful and jealous neighbors: Persians, Byzantine Greeks, Arabs, Seljuk and Ottoman Turks, and Russians. This explains in part why the Armenians have never set up a solid, lasting state and why their history right up to the present has been so tragic. Furthermore, the Armenians have never been able to settle their internal troubles. They are quarrelsome people among themselves, and the constant state of civil strife in which they have lived has been fostered and made the most of by their neighbors. Nevertheless, though torn by almost continous struggles among her feudal lords (at one time there were no less than six rival "kings"), Armenia in the Middle Ages long managed to maintain a precarious and turbulent existence as an independent nation in the face of extraordinarily adverse circumstances both external and internal. The frontiers were continuously changing, and the entire state moved from a ninth-century home in the vicinity of Lakes Van and Sevan through various intermediate locations to the plains of Cilicia, where the Kingdom of Little Armenia, founded in the twelfth century, long lingered on as an outpost of civilization against the rising tide of Turkish conquest which was finally to overwhelm it.

Today Armenians are found not only in the regions now and formerly called "Armenia" but also in Constantinople as well as in large colonies throughout Anatolia. This is to a large extent the result of events that took place in the Middle Ages. Love of adventure, aggravated by abuses at home and the injustice of a feudalism which, if not actually depriving them of a share in their deceased father's property, subjected younger sons to the tyrannous feudal overlordship of their elder brothers, led to a continuous emigration of soldier-adventurers from among the nobles as well as of men of more humble estate. The lands and cities of the Byzantine Empire were the goal of most of these emigrants, who formed the nuclei of large Armenian colonies destined to preserve their own speech, customs, and traditions down to the present time.

AUSTRALASIA AND OCEANIA

Nauru: A Treasure Island of the Pacific. Situated in the central Pacific, 33 miles south of the equator and a few degrees west of the Gilbert Islands, is Nauru Island, famous for its vast deposits of the invaluable fertilizer, phosphate of lime. The island is 12 miles in circumference, 5,000 acres in extent. It has wide, flat foreshores, with a group of picturesque hills in the center, the location of the phosphate rock. Running completely round the island is a well-made, well-kept road sheltered by an avenue of coconut palms over eighty years of age. Though so near the equator the climate is comparatively cool and notably salubrious.

The Nauruans are a handsome, intelligent race. They are divided into two classes, the wealthy and ruling class, and the people, called "slaves of gratitude" from the fact they are maintained, that is fed and clothed, by the rich classes who control them. At the same time there is nothing of slavery in this control, and the people are happy and contented. They are loyal to their king, Oweida by name, and the ruling chiefs under him, and caste is strictly recognized. The people are quite free from all brutal tribal customs and obey but one law, that of the British administration. They are all quite civilized, many of them earning good wages working in the phosphate industry.

The sea around the island abounds with a great variety of fish, and the natives go out in the roughest weather in their frail canoes, returning in a few hours with large quantities of fish. These are not killed and eaten but are carefully conveyed alive to beautiful lagoons, or small lakes, in the hills. Every village owns a lagoon, and every villager a portion of

the water, which he fences off with palm leaves. The fish are put into these "paddocks" of water; and the housewife, whenever she requires fish for her household, goes off to the lagoon and with her hands catches all she wants. One Nauruan dance is a drama representing a fishing expedition, wherein the dancers have live fish tied to their heads, chests, arms, and legs. The weird effect can be imagined: as the dancers move the fish wriggle, their silvery scales against the black skins sparkling brightly in the glare of great palm-leaf fires.

The national sport of Nauru is the maintaining and capturing of hundreds of frigate birds, solemn-looking creatures of no use and not ornamental. In the season when these birds are plentiful gala days are arranged when owners of birds assemble at a rendezvous on the beach. Great roosts like skeleton roofs of houses are carried in procession from the villages, and these are covered with birds securely tethered, among them being some decoy birds. The decoys are uncanny creatures that display an intelligence almost human in the way they do their work. The decoys are let loose and instantly soar aloft to attract wild birds. These, at first unseen, presently come wheeling overhead in great numbers, are enticed to the roosts, and are promptly caught and tethered by young natives hidden below. At nightfall a count is made of the captures of the day, and the native king in an elaborate address proclaims the village that is the winner. During the rest of the night there is feasting and dancing; at daybreak the roosts are taken up, and all return to their villages.

Forty years ago the Germans took possession of this tiny island valued then but as a link in the chain of territories which the German Imperial Government hoped would surround the Pacific and give Germany mastery of the southern hemisphere. Before the war, while the full value of Nauru had been recognized by the Germans as a source of phosphate (huge royalties were derived from the exploitation, which was in the hands of a British company), they nevertheless considered the island still more valuable as a strategic naval station. On it was installed the most powerful wireless station of pre-war days—a station which played a very active part in the first weeks of the war as far as the Pacific was concerned. The general neglect, however, of so useful an island was hardly in accordance with German policy in the South Pacific, for on all other German islands the government and settlers did much to promote development and commerce, achieving therein signal success.

Since 1914 British administration has been in force. The administration promptly took an interest in the natives, especially in improving and making profitable the native coconut plantations and in the attention paid to health. A fine native hospital has been built and is excellently managed by an American doctor who has done wonders in coping with native diseases.

Meanwhile the rich phosphate deposits have made Nauru a "Treasure Island" in the eyes of many nations. Japan (who has secured the phosphate-producing island of Angaur in the Pelew Islands) claimed it as part of the German territory of the Marshalls, though it is south of the line. Australia and New Zealand both put in strong claims. The mandate, however, has been given to the British government. An agreement made subsequently divides the phosphate: the United Kingdom and Australia each receive 42 per cent of the output, New Zealand the remaining 16 per cent. It has been estimated both by British and German experts that there are at least 40,000,000 tons of phosphate rock on the surface of the hills, which can be mined and collected with little effort. The industry, which has been in the hands of a British enterprise known as the Pacific Phosphate Company, will be placed under the management of a commission whose officers are to be appointed by the English, Australian, and New Zealand governments. It is expected that the working staff, one with years of experience, will be continued and that the industry will be carried on without interruption.

The phosphate industry is justly accounted a notable enterprise. When it is borne in mind that Nauru is in one of the most remote parts of the world and that it costs much time and money to get there and back, nothing but praise can be given to the plucky British company that set up its machinery there and has for twenty years been supplying the agricultural world with one of the most necessary of soil constituents. The Nauru industry has all the accessories of a great modern enterprise—cantilever jetties, railways, steam and electric power, electric light, telephones, fresh and salt water-supply systems, and splendid sewerage. Welfare and living conditions of all employees are among the best regulated in the world. Chinese coolies, with Caroline, Marshall, and Nauru natives, under a competent staff of white people number in all upwards of a thousand people. The scene is always

busy, the activity the more surprising as one emerges from the solitude of the ocean. Over 100,000 tons of phosphate is exported annually, and in the future this output is to be doubled.

Thomas J. McMahon

The Mystery of Easter Island. Easter Island has long attracted attention as presenting one of the most interesting problems of Pacific ethnology. Towards its solution the Scoresby Routledge Expedition, at work on the island from 1914 to 1915, made notable contribution. An outline of the results accomplished by the Expedition was given in the *Geographical Journal* (Vol. 49, 1917, pp. 321–349) and abstracted in the *Geographical Review* (Vol. 4, 1917, pp. 221–222). Since then the narrative of the expedition has appeared under the title "The Mystery of Easter Island" (London, 1919). This volume by Mrs. Routledge is finely illustrated and agreeably written. In addition to the stay on the island Mrs. Routledge describes the journey thither and back in the specially designed schooner yacht *Mana*. Going out the *Mana* proceeded via the Strait of Magellan, the Patagonian waterways, and Juan Fernandez. On the homeward course by the Panama Canal, Pitcairn Island and Tahiti were touched. Detailed scientific results will be published in a second volume.

More recently (1917) Easter Island was visited by Carl Skottsberg and members of his expedition engaged in a biological survey of Juan Fernandez (see the article "The Islands of Juan Fernandez," *Geogr. Rev.*, Vol. 5, 1918, pp. 362–383). Certain interesting features of the island are briefly recounted in "Notes on a Visit to Easter Island" (extract from "The Natural History of Juan Fernandez and Easter Island," edited by Carl Skottsberg, Vol. 1, Upsala, 1920). The visit was short, and the object was primarily biological; but the people and the culture inevitably claimed some attention, and approving comment is made on Mrs. Routledge's deductions concerning the origin of the Islanders and their mysterious handiwork. Legendary tradition indicates populating of the islands by two main migrations, the earlier Melanesian, the later Polynesian. Dr. Skottsberg considers that relations with the western Pacific are clearly demonstrated in the similarity of the peculiar bird cult with that of the Solomon Islands (where the frigate bird is worshipped).

As a source still incompletely investigated attention is called to a critical examination of the language especially to the names of cultivated plants. *Cumara* is cited as a case in point. The sweet potato is known under this name from New Zealand through Polynesia to Easter Island. The word is also said to occur in Quechua and by some writers has been advanced as a proof of relations between western South America and Polynesia in pre-Columbian times.

Regarding the Easter Island culture Dr. Skottsberg makes comment on the physical conditions of life on the island. "The great scarcity of water makes the high development of the ancient culture quite astonishing." There is no running water on the island; sources are limited for the most part to lakes in the craters. One "cannot fail to notice the absence of every trace of valley or ravine caused by the action of running water." The rainfall indeed is considerable; for 8 years an average of 48 inches is recorded; but the volcanic soil is extremely porous, and under the hot sun and strong winds evaporation is high. Contrast with the islands of Juan Fernandez, situated 7° farther south and highly dissected by erosion, is most marked. Vegetation on Easter Island is poor. Apparently the island was never wooded; today only a few stunted trees exist. The greater part of the surface is covered with grass.

Dr. Skottsberg's paper is accompanied with a map (1:200,000) based on that of the Chilean Hydrographic Office; elevations, however, being given according to his own observations, which differ considerably from those of the Chilean map.

Agricultural Climatology of Australia. What is the rainfall, its reliability, its seasonal distribution? Tell the Australian agricultural climatologist, and he will indicate what part of his continent is referred to and what its chief agricultural products are. This, in effect, is demonstrated in Dr. Griffith Taylor's article, "Agricultural Climatology of Australia" (*Quart. Journ. Royal Meteorol. Soc.*, No. 196, Vol. 46, 1920, pp. 331–356). The delimitation of rainfall regions by these criteria give us the agricultural regions. The four major ones are: "The summer rain region in the north, the winter rain region in the south, the uniform rain region in the east, and the arid rain region in the center and middle west."

The hot north, because of its dry season and practically unbearable heat for any white man not doing more than light work, *e.g.*, riding with cattle in the open, is used for nothing but a sprinkling of cattle (it appears to be too hot for sheep).

The arid region of a million square miles contains less than one per cent. of the cattle and sheep of Australia. Aside from fodder, water for live stock is the limiting element: and cattle fare better than sheep, for cattle can cover so much greater distances.

The narrow, winter rain region in the south, with its subtropical location and reliable though moderate winter rainfall, supports chiefly wheat, sheep, and vines.

The uniform rain region in the east is the portion of Australia where the great majority of the people live and raise their crops and live stock. In the tropical section, Queensland and northeastern New South Wales, the summer maximum of rainfall and its quantity favor such crops as sugar cane on the coast and maize where the rainfall is less. There is plenty of timber in the rain forest, and in the drier interior cattle and sheep raising and some irrigation farming are carried on. Farther south, in southeastern New South Wales, Victoria, and the extreme southern part of Western Australia is the principal wheat and general farming and fruit-raising region. From the drier to the wetter parts, wheat, hay (largely grain cut green), oats, barley, and various fruits, grapes, oranges, peaches, apples, and pears are raised, and dairying is carried on. There is also an appreciable lumber industry. The winter maximum of rainfall and the dry summers are particularly favorable to wheat raising. Tasmania is wetter and cooler, its climate and products being very much like those of western Washington. Timber, oats, and dairy products are characteristic.

The agricultural future of the arid heart of Australia is not bright. Although there are more than two million square miles (more than two-thirds of the entire continent) which cannot be adequately developed without extra water, the irrigated areas in 1915 amounted to only a thousand square miles. However, the eastern mountains are well watered, and there are large artesian basins (under about two-thirds of a million square miles in the east-central part) which may be tapped for irrigation water; and big reclamation projects are under way. One alone is expected to provide ultimately 6,000 farms and a livelihood for 100,000 people. Drought is the ever-present menace of the principal cattle and wheat regions. Provision of better transportation facilities in these regions will allow the removal of live stock to better feeding grounds during droughts and thus prevent the heavy losses of the past.

Charles F. Brooks

PHYSICAL GEOGRAPHY

Three Mountaineering Books; The Mt. Everest Expedition. Though most mountain climbing as an athletic sport contributes little or nothing to geographical knowledge, three recent mountaineering books and an ambitious plan for the ascent of the highest peak in the world are not without geographic interest.

In "Mountain Memories" Sir Martin Conway, former President of the British Alpine Club, looks back over a long and varied career of climbing in many ranges from Bolivian Andes to Karakoram, from Spitsbergen to Tierra del Fuego. The sporting and aesthetic aspects of mountaineering were always foremost in Sir Martin's spirit: he was Professor of Art at Cambridge, and the subtitle of his book is "A Pilgrimage of Romance;" but "Mountain Memories" also gives us a subjective insight into the evolution of a real and deep geographic enthusiasm. Sir Martin undoubtedly has that indefinable "geographic sense" which enables him to paint in vivid word pictures the appearance of mountain scenery in widely varied regions. Certainly books which make us "see" landscape fill an important place in geographical literature even though they make no pretense at being scientific.

"Mountain Craft," edited and to a large extent written by G. W. Young, and "Mountaineering Art," by Harold Raeburn, are handbooks for the climber and deal with matters of technique. They discuss in detail and with the discrimination of experts such practical questions as equipment, guides and guideless climbing, ice, snow, and rock work, mountaineering on skis, etc. Young is especially interested in the human and psychological aspects of mountaineering; his chapters on management and leadership contain many shrewd but sympathetic analyses of human emotions and impulses under conditions of fatigue, hardship, and danger. Though no man can learn from books either the art of leadership or the art of getting along with fellow travelers, Young furnishes many ideas that could be profitably considered by anyone planning to conduct geographical exploration whether on mountain snows or in warm lowlands. Both books deal with mountain reconnaissance and exploration. That skill in this branch of mountaineering art is of the utmost utility to geographer,

geologist, surveyor, and miner, whose business takes them into high ranges, will be recognized by all. Raeburn claims that some knowledge of geology is essential to the exploring mountaineer in order that he may tell "from a telephotograph, or a view through a glass at many miles' distance, the probable nature of the climbing on the peak he is aiming at" (p. 236). According to Young an adept in mountain reconnaissance can often judge whether he may expect to find rock, or ice, or névé on the opposite side of a range by the appearance of sky above the ridge crest. These are examples of some of the fine points of mountain reconnaissance. "Mountain Craft" concludes with a series of chapters by specialists giving valuable advice for would-be climbers in different parts of the world: the tropics, the Arctic, the Caucasus and Himalaya, Norway, New Zealand, the Pyrenees, Corsica and the Rocky mountains.

The Royal Geographical Society and the Alpine Club have this year organized a joint expedition for the ascent of Mt. Everest. Recent numbers of the *Geographical Journal* (January to May, 1921, inclusive) and the *Alpine Journal* (March, 1921) contain articles and notes on the geography of the Mt. Everest district, on Himalayan mountaineering in general, and on the plans for the expedition. Up to the present nobody has ever been within fifty miles of the highest mountain in the world. Telephotographic views of it from a distance give a most unsatisfactory idea of its topography because intervening ridges of immense height cut off from sight all but the very peak itself. Consequently a prime requisite will be the carrying out of a thorough survey of the mountain and its approaches. This will be the work of the season of 1921. It was planned for the party to leave Darjeeling in May and to work around to the north, or Tibetan, side of Everest by way of the Tang La Pass and Kampa Dzong to Tingri Dzong. As the bird flies an approach from the south would be more direct; but the southern side of the mountain lies in Nepal, a country closed to foreigners. Travel will also be easier to the north. The Tibetan slopes of the Himalaya as a whole have undergone less denudation and consequently are gentler than the Indian slopes; snow line is at a higher elevation (probably about 20,000 feet) owing to the fact that much of the moisture of the southwest monsoon is precipitated on its ascent of the windward slopes; yaks can in all probability be used as a means of transport through high, bare valleys and over arid ranges almost to snow line.

The preliminary reconnaissance of 1921 will certainly reap geographic results of great value; it goes without saying that much will be learned about Mt. Everest itself. In addition an immense unexplored tract to the north, northeast, and northwest will be revealed—a tract in which distant views have shown the presence of mountains of enormous height, rivaling, though probably not exceeding, that of Everest itself.

The attempt to reach the summit, scheduled for 1922, is to be led by Harold Raeburn, author of "Mountaineering Art." Mt. Everest rises over 4,500 feet above the highest recorded point to which man has climbed. The latest figure for the elevation of Mt. Everest is given by the *Geographical Journal* (January, 1921, p. 14) as 29,141 feet. The highest point reached by the Duke of the Abruzzi on Bride Peak, Karakoram, is 24,600 feet (the *Alpine Journal*, March, 1921, gives 24,583 feet). It is possible that at these immense altitudes wholly novel conditions of snow and ice may be found. The chances of success in the dash for the top will depend largely on atmospheric conditions; one thing in favor of the climbers is the fact that Everest lies relatively far back from the plains of India and is more or less masked by intervening heights from the clouds and snows brought by the monsoon. Probably the most interesting result of the expedition will be the new light that it will shed on human acclimatization to a combination of low air pressure with very low temperatures, for at the present time there is little uniformity either of opinion or of experience on this subject.

TERMINOLOGY AND ORTHOGRAPHY

The Spelling of Geographical Names. The origin and activities of the Permanent Committee on Geographical Names composed of representatives of interested departments of the British Government and of the Royal Geographical Society are described in brief by the chairman, Major General Gleichen in the January number of the *Geographical Journal*. The Committee had its inception, it is said, in the British Admiralty's dilemma over "what to call the place generally known as Walfisch Bay." A preliminary conference was held in April, 1919, and the Committee came into being the following month. The first concern of the Committee was to draw up a series of "Rules for the Spelling of Geographical Names for British Official Use" and a standard "Table of Spelling and Pronunciation." Both are

included in the above mentioned article. Together they are known as the R. G. S. II System and are based on an earlier system formulated by the Royal Geographical Society in 1865. Preparation involved such investigations as the scheme of Arabic transliteration described in the October, 1920, number of the *Geographical Journal* and the transcription of alphabets of some 32 languages which are to be published as No. 2 of the R. G. S. Technical Series. Work now being pursued with urgency includes the preparation of lists of place names in the territories of Britain's African mandates, Tanganyika Territory, Cameroons, and Togo, in order to settle spellings before they have time to "crystallize in wrong forms." Lists of the names are to be published from time to time as leaflets in the *Geographical Journal.* The first leaflet makes its appearance with the April number under the title "First General List of European Names." It may be obtained separately for the sum of sixpence from the Royal Geographical Society, Kensington Gore, London, S. W. 7.

GEOGRAPHICAL REVIEWS

A Geographical Study of the Peace Terms

M. I. Newbigin. **Aftermath: A Geographical Study of the Peace Terms.** 128 pp.; maps. W. & A. K. Johnston, Ltd., Edinburgh, 1920. $1.50. 7½ x 5 inches.

In the April number of the *Review* note was taken of Demangeon's striking essay "Le declin de l'Europe" (Paris, 1920). It was pointed out that certain natural remedial measures had been at work in the interval between the writing of the book and the publication of the review and that these, in part at least, diminished the force of the author's conclusions. We now have in Miss Newbigin's book a brief essay of similar character dealing with the territorial side of the matter. She attempts to give "an outline picture of the Europe which emerges from the various peace treaties, without assuming that 'Conference' Europe is likely to remain permanent." While criticizing some of the treaty decisions, the author has a lively appreciation of the peculiar problems that confronted the treaty makers, many of which were due to the state of mind in which they found the world in 1919. By far the best part of the book is the first chapter of fourteen pages, dealing with geographical principles and such questions as the rise of nationality, the relation of people to the land, the contrast between economic and nationalistic groupings, and, particularly, the contrast between the industrial life of western Europe and the primarily agricultural life of eastern and southeastern Europe. This general discussion ends with a point of great importance—that the conflicting forces of the Old World are still at work and that they will in the long run determine the political destiny of Europe and of the world, so little changed fundamentally by the war and the various peace treaties.

The chapters from 2 to 9, inclusive, take up the regional problems of large natural or political units, like eastern France and Belgium, Poland, Austria, Rumania, etc., and conclude with a brief note on Germany's oversea possessions. In this, the main part of the book, there is a small amount of philosophical writing, most of the material being descriptive and statistical. There are thrown into orderly form the main facts of territory, population, and boundaries, already widely known through the published peace treaties. The space allotted to the various topics is too small to permit the placing of the main facts in a proper historical and geographical setting, though the book has numerous suggestions of high value, reflecting the wide reading of the author.

Some of the statements that relate to the negotiations themselves are hardly reliable. It was never seriously proposed by the treaty-making powers to re-create Poland by simply annulling the partitions of a century and a half ago and throwing Poland's eastern boundary out into mid-Russia (p. 27). Nor was it a political action "based upon abstract principles" that was responsible for the establishment of the Free City of Danzig. It seems all the more strange that such a statement should be written by a British citizen. When the unanimous recommendations of the Polish Commission for the inclusion of Danzig in the Polish state were rejected by the Supreme Council it was on account of British opposition to that course rather than the application of the "abstract principles" of President Wilson. Whatever motive impelled the British leader to oppose some of his own advisers and insist upon the creation of a Free City, it can hardly be less than obvious that the creation of such a city is of great advantage to British trade. And when the author goes on to say that it is doubtful if the solution (Danzig a Free City) can be *permanent* unless the new world is very different from the old one, the reviewer would feel inclined to remark that the solution has at least a chance of being as permanent as the British Empire (p. 30).

The spirit of some of the statements seems curiously alien to common knowledge of some fairly well-known facts. It is leaning over backward to say that "there are signs at least that mineral oil is likely to increase rapidly in importance" (p. 13); and that the Upper Silesia plebiscite solution, as "a late addition to the Treaty," is a working hypothesis that "seems to account for some of its [the Treaty's] anomalies" (p. 32). Surely these things are matters of common knowledge. That river boundaries were selected along the western frontier of Poland is taken as evidence that the boundary makes no pretense to be a strategic one (p. 34), whereas the precise reason for selecting rivers was a strategic one. Even small

brooks may have a high strategic importance in the early stages of a campaign when by the use of machine guns a few men can hold large areas. While such streams can be crossed at any time that it suits the higher military command to cross them, there is always an added price which has to be paid for overcoming this or any other obstruction.

Like almost all others who have treated the subject, the author emphasizes the apparently impossible economic state into which some nations were thrown by the rearrangement of the boundary lines. She finds that the treaty makers "clung desperately to the 'principle of nationality'" (p. 88); that the western Rumanian boundary "cuts streams, canals, railways, and even minor ethnical groupings more or less at random" (p. 78). One has to face the fact that *any* solution of the problems of territory and nationality in Europe would be violently attacked by powerful groups. It would hardly have comported with the spirit of the times to have denied the rising states of central Europe the nationality for which they fought. Their aid seemed important if not vital at one time or another during the war; and to have retained the old boundaries would have been to reward them by turning them over to their historic masters. Hardly anyone would have accepted a possible third solution—the creation of economic groupings to be maintained by force under conditions that would have given superior power if not superior authority to the former ruling caste.

Pastoral Industry in the Economic Development of Spain

Julius Klein. **The Mesta: A Study in Spanish Economic History, 1273–1836.** xviii and 444 pp.; map, ills., bibliogr., glossary, index. (Harvard Economic Studies Vol. 21.) Harvard University Press, Cambridge, Mass., 1920. 9 x 6 inches.

Among the several fundamental Hispanic institutions which have been the subject of study during the last two decades none is of more interest from the viewpoint of geography than the one which forms the theme of this volume. The Mesta was an organization of the sheep owners in Spain, the chief function of which was the protection of their migratory flocks. The entire basis of the institution, as of the sheep migrations from which it sprang, was geographic. Neither Spain's extensive sheep raising nor this influential organization of the large-scale migratory pastoral industry would have existed except for the peculiar physical environment of the Iberian Peninsula.

Spain early became a pastoral country. The great semiarid, almost treeless *meseta* that occupies over one-half of the peninsula contains large areas that are suitable only for grazing (see Eduardo Reyes Prosper: Las estepas de España y su vegetación, Madrid, 1915). So little agriculture was possible in these regions that stock raising developed, not as an adjunct to husbandry, as in most other European countries, but as a separate occupation. Here, for centuries, have been raised the famous cattle of the Guadarrama hills and the merino sheep whose wool long supplied the choicest grades for European markets. During much of Spain's history the produce of her flocks has been her one important contribution to foreign trade.

Seasonal migration of flocks arises from various conditions. Sometimes, as in central Chile, the low pasture lands dry up in a rainless summer, forcing the herdsmen to move their flocks to moister mountain ranges. Again, as in Argentina on the opposite slope of the Andes, the herds are driven to the mountains during the season when rains prevail upon the plains, chiefly in order that the herds may escape the heat of the summer and the insect pests that accompany it, or that their principal feeding grounds may be allowed to recuperate. In Mediterranean countries migration is practiced chiefly in search of winter ranges when the mountains are inhospitable.

In Spain there are two great pasture zones. The first is the hill country, consisting chiefly of the Cantabrian-Pyrenees mountain system, of the Gredos, the Guadarrama, and the Ibérica ranges, and of the Serranía de Cuenca. The second zone includes some of the river valleys within the plateau, such as those of the Ebro, the Duero, and the Tagus, with upper sections of the Guadiana; extensive lowlands south of the plateau; and several districts within the southern half of the plateau itself, chiefly the steppes of La Mancha and Murcia. The sheep belong upon the highlands, where during the summer months they graze upon the hills. This is the dry season, but sufficient grass is found for their subsistence. In winter, snow covers up even this scanty pasture, and the bleak winds imperil flocks and shepherds alike. They are then forced to migrate to other regions. Sometimes pasture can be found in neighboring valleys, but usually journeys of several hundred miles are required before

they can reach districts where there is both a mild climate and sufficient grass. Fortunately while the plateau is receiving its winter snows (almost the only precipitation it enjoys) the southern plains are freshened by warm rains that make for the best of pasturage there. Some six months later the south becomes dry again, and the flocks must return to the highlands. Thus neither zone serves for perennial grazing, and the flocks must journey back and forth in search of feed (see André Fribourg: La transhumance en Espagne, *Ann. de Géogr.*, Vol. 19, 1910, pp. 231–244, with two maps).

It was under such conditions that the Mesta originated. In their journey across the central plains and through the southern borderlands in search of pasture these flocks were looked upon as intruders. Every town and peasant farmer, every feudal landlord resented the yearly eruption of these migrating herdsmen from the north, with their thousands of slowly moving sheep, for which they must find subsistence along the way. Taxes, tolls, and various assessments were invented to annoy the strangers and to enable the sedentary agriculturists of the south to reap some benefit in recompense for the damage wrought by these invaders. In order to resist the extortions practiced by local officials the herdsmen united and organized a system of common defense, with regulations that governed the migrations, a system of caring for the strays that frequently became separated from their flocks, and a corps of officers to protect their common interests. During several centuries this guild of sheepmen (supported by the crown, which saw in it a means of counteracting the *regionalismo* that has always afflicted Spain) dominated the pastoral industry of the country and exerted a strong influence upon the agrarian development, upon agricultural life, and upon the general economic condition of the nation. It is the internal organization of this powerful body, its external relationships, and its economic influence upon the country that are treated in the volume under consideration.

No thorough study of the Mesta had ever been made, and the work is based principally upon material found among the almost untouched archives of the Mesta itself. The four parts of the study treat respectively of the organization, the judiciary, taxation, and pasturage. Heavily documented, as such a study in an entirely new field must be, it at once becomes the standard work on the subject treated and leaves one less area unexplored in the field of Spanish institutional history.

Although it is frankly acknowledged by the author that geographical factors lay back of the practice of migrating, there is nowhere any satisfactory description either of the various grazing lands occupied by the flocks in different seasons or of the climatic conditions that made such migration necessary. The volume is concerned chiefly with the organization and the economic influence of the Mesta as an institution, yet some such account would seem essential as an explanation of the setting in which developed the migratory pastoral industry and which gave rise to the Mesta itself.

This volume on the Mesta brings out clearly the great need for further painstaking research into the underlying economic conditions in Hispanic culture. Two important matters, closely related to the present study and suggested in its pages, offer attractive fields for investigation—the land system of Spain, and the character, history, and place in the national life, of the Spanish town.

Geographical and Statistical Data on Hungary

Gustavus de Emich, Aladár de Edvi Illés, and Albert Halász, edits. **Magyarország Gazadasági Térképekben (The Economies of Hungary in Maps).** 2nd edit. 74 maps, 6 diagrs. Budapest, 1920. 10½ x 15 inches.

Critics of Hungarian official statistics find the figures of nationality so much distorted, to the advantage of course of the Magyars, that they are apt to convey to persons not conversant with the material an impression that the government statistics as a whole are uninforming and unreliable. Such an impression is mistaken. In statistics of social and economic interest the government provides accurate information more detailed than that which is available in most of the other countries of Europe. The present publication uses this information to picture the conditions of the country as they were about 1910. Most of the maps present as a base the Kingdom of Hungary within the frontiers as they were in 1914, but each map is accompanied by a transparent sheet on which are printed both the old frontiers and also the boundaries established for the new Hungarian state by the Treaty of Trianon, so that the student can readily estimate the significance of the territorial losses resulting from that treaty.

The atlas includes in all 74 maps and 6 diagrams. The subject covered most elaborately is Industry and Mining, with 29 maps. Next in importance come the subjects of Agriculture and Forestry, 18 maps; Population and Education (including prehistoric settlements, ethnography, literacy, emigration, land tenure, and publications), 8 maps; and Traffic, 7 maps and 4 diagrams. Of the remaining maps 3 are devoted to Energy (coal production, coal reserves, water power, and total energy developed), and the rest cover general and miscellaneous topics.

The section on Industry and Mining is unduly swollen by maps picturing the distribution of minor industries, such as those producing bricks, vegetable preserves, vegetable oil, soap, and candles. On the other hand it gives no map showing the distribution of industrial establishments according to size, although the statistics provide abundant means to illustrate this important aspect to modern industry. Maps showing the subsidies granted by the government to industry are of interest in that the government appears, contrary to what one would suppose, to have been most lavish in the outlying parts of the kingdom, notably in the Slovak districts of the north. In the section on Agriculture most of the crop maps picture area planted, not crop yields; but one map, showing the surplus or deficiency of cereals by counties, brings out clearly the interdependence of the different parts of the former kingdom in the production and consumption of these staples. Two maps in the section on Traffic are noteworthy, in that they distinguish the amount of freight and passenger traffic on the various lines of railroad; information of the kind provided by these maps is not easily procured, for either Austria or Hungary, and is of great value in framing a judgment of the economic relations of the country. Most of the maps are on the scale of 1:4,000,000. The ethnographic map by Professor Paul Teleki is on the scale of 1:1,000,000 and essays to show not only the linguistic distribution but also the density of population, by assigning a square millimeter of the appropriate color to each 100 inhabitants in a district. The map cannot be called a success, unless (as possibly was the case) it was designed to emphasize the ascendancy of the Magyars.

The maps in this atlas are more eloquent than printed pages in convincing the student of the grievous losses which Magyar Hungary brought upon itself in the war. The partition of the old kingdom cut to pieces an organic whole and entails an economic readjustment which will be a slow and most painful process. Magyar Hungary retains one valuable asset—the fertile plain which produces a handsome surplus of food. It fares well enough in the distribution of the current coal product. It loses the larger coal reserves and most of the other mineral resources of the kingdom. It loses the upper course of the rivers and much of the potential water power; it loses its timberland; it loses a great market for its industrial products. It has only the sorry consolation of knowing that, low as it has sunk, it still is better off than the new Austria.

Clive Day

Louis Lóczy, edit.; with contributions by several Hungarian scholars. **A Geographical, Economic and Social Survey of Hungary.** (Publications of the Hungarian Geogr. Soc.) 121 pp.; maps. "Pátria" Press, Budapest, 1919. 6 crowns. 9½ x 6½ inches.

Before the outbreak of the war the Hungarian Geographical Society had published a work whose title in English is "A Geographical, Sociological, Cultural and Economic Description of the Crown Lands of St. Stephen." The main object of publication was "to have it translated into foreign tongues and thereby to propagate a knowledge of the Hungarian kingdom based on authentic data." The volume listed above is an extract of that part of the work dealing with Hungary proper prepared for the peace negotiations. While naturally propagandist in character, it gives much useful descriptive and statistical matter—notably in the chapters on agriculture, forestry, mining, industry, and commerce.

Moroccan Landscapes Seen from the Air

Jules Blache. **Quelques aspects des montagnes marocaines.** Maps, diagrs., ills. *Rev. de Géogr. Alpine*, Vol. 8, 1920, No. 2, pp. 225–258. Grenoble.

In an earlier paper (De Meknés aux sources de la Moulouya: Essai d'exploration aérienne au Maroc, *Ann. de Géogr.*, Vol. 28, 1919, pp. 293–314) M. Blache gave an account of valuable aerial exploration in Morocco and thereby greatly added to our knowledge of the country. Previously information regarding the mountains and plateaus of Morocco had been derived from descriptions such as those of Gentil, De Segonzac, and Fischer, while it was possible to

turn to the excellent topographic maps of Algeria for accurate representations of features, which seem from the descriptions to resemble closely some of the Moroccan types of land forms. We have in the present paper a series of eighteen air photographs, comprising both oblique and vertical views and accompanied by clear explanatory descriptions, which form an exceedingly valuable aid in the study both of Moroccan geography and of land sculpture in general. For the photographs are prepared not merely as views of Morocco but also as illustrations of the mechanism of denudation processes acting on varied structures in a rather arid climate. The views are chosen from several thousand taken in reconnaissance flights by the Moroccan military aviation service. We are informed that the views show typical—and never exceptional—landscapes of the large zones they represent. These zones are as follows: The Meseta, with its two main types of country, (1) the dissected plateaus of flat-bedded sediments and (2) the Jebilet, or residual hills of crystalline rocks which project through sediments; the Central Atlas Mountains; the plain of the upper Moulouya to the east of these ranges; the Great Atlas Mountains of the southwest; and the Rif in the north. A sketch map shows the location of each view.

We find the Central Atlas to be a range of simple structure—anticlinal ridges, monoclinal valleys, and antecedent gorges. The plain of the upper Moulouya is revealed as an arid region, slightly dissected by wadis with irrigated strips along them and with flat-topped tables between them. The Great Atlas south of the Moulouya again shows marked simplicity of form as well as great aridity. In the Rif a great contrast to the other ranges is presented. Evidently the structure is much more complicated. The ranges are dissected to a much greater extent; and in the photographs we see mature valleys, wide, waste-filled basins, and braided rivers.

In the oblique panorama of the dissected plateaus of the Meseta we have an excellent example of the natural contours produced by the alternate outcrop of strong and weak strata, a feature which proved so useful in plotting of form lines on maps prepared mainly from air photographs during the war in Macedonia, Gallipoli, Palestine, and Mesopotamia.

A Geographical Interpretation of Early Biblical History

William Willcocks. **From the Garden of Eden to the Crossing of the Jordan.** viii and 93 pp.; maps. Printed by the French Inst. of Oriental Archaeology, Cairo, 1918. 5s. 10 x 6½ inches.

Interesting and suggestive is this geographic interpretation of the sacred books of Genesis and Exodus by Sir William Willcocks, irrigation expert, designer of the Assuan dam in Egypt, and director of the recent British reclamation works in lower Babylonia. For thirty-four years the author has studied on the spot every episode in the Bible concerned with irrigation. He has come to the conclusion that the stories of the Garden of Eden and Noah's Flood in Mesopotamia, like that of Joseph's famine in Egypt, the ten plagues, and the exodus of the Israelites, all had to do with the control of water in these rainless lands—with irrigation systems established, tampered with, or destroyed. Along the Euphrates he found only two districts which could be irrigated by free flow all the year round and which therefore might have been the scene of the Garden of Eden. One was the reclaimed marshland above the Persian Gulf near the ancient Eridu, site of the Sumerian Garden of Eden. The second lay on the middle Euphrates between Anah and Hit, where a series of cataracts, now much degraded, enabled the benches of alluvial deposit above the present flood line to be irrigated by water drawn off above the falls. Here the author locates the Semitic, or biblical, Garden of Eden. The four distributaries of the river of Eden he identifies as the four offshoots of the Euphrates below Hit, namely, the Kerbela branch, Hindia, Saklawia, and Euphrates proper; and he explains the expulsion from Eden by the degradation of the cataracts below the level of the river terraces, which put an end to irrigation and made the banks revert to desert. It is a question, however, whether two sites for the Garden of Eden are necessary, since the Semitic story was clearly borrowed from the earlier Sumerian version.

The author is most interesting and convincing when he uses his expert knowledge to interpret the Egyptian stories of the Bible. With Cope Whitehouse he places the fortress of Ha-Uar, key of Lower Egypt in the Hyksos period, not at the gateway of the ancient military route from Philistia but at the dam across the canal connecting the Nile with Lake Moeris; because an enemy in possession of this strategic point could cut the dam, draw off the Nile into the Moeris depression, and deprive Lower Egypt of its water supply. This was the explanation of Joseph's famine. At that time Ha-Uar was the frontier fortress

between the Hyksos rulers of Lower Egypt and the Pharaohs of Upper Egypt. Joseph probably learned from a fellow prisoner of the plans being made by the Theban king to seize Ha-Uar and the regulator of the canal. Hence his prediction of the year-long famine, and the storing of grain and provisions before the campaign from the south should finally be set on foot. At last the catastrophe came: the regulating dam at Ha-Uar was seized and cut by the Theban forces; the Nile failed to overflow its banks in the Delta, and the predicted famine arrived. The recovery of Ha-Uar several years later was followed by the reconstruction of the dam and the restoration of Lower Egypt to its normal productivity.

In regard to the plagues of Egypt, the author shows that not only did they happen "in the field of Zoan," or northeastern part of the Delta, but that they might happen there today under a combination of low Niles and internal disturbances which should interfere with the irrigation system. He also proves that eight of the ten plagues could have occurred only in this northeastern part of the Delta and that they were inoperative in "the land of Goshen," or Wadi Tumilat district inhabited by the Israelites, because of the abundant subsoil water in this valley. Moses took advantage of a low Nile to tamper with the water channels in the Zoan, or Tanis district, and to bring on a succession of plagues, seven of which followed in a sequence of cause and effect.

The author rejects as impossible the traditional Red Sea route of the exodus from Egypt and revives Brugsch's theory of a course along the Pelusiac branch of the Nile across the Desert of Shur to the Mediterranean, and thence to Edom. This theory he supports with fresh arguments in which Moses again appears as an engineer hero comparable to Heracles. The term translated "Red Sea" in the Bible means reedy sea or reedy river or fluvial bog. Reference in Exodus is to an old arm of the Nile temporarily severed from the main stream, probably the Pelusiac branch, which Moses may have dammed up to flood the upper basin and drown the growing crops of Zoan and which he suddenly released to overwhelm the advancing Egyptians as they were crossing the muddy channel below the dam. Similar miracles performed by Moses as instrument of Jehovah resolve themselves into rational achievements normal to a man familiar, as Moses doubtless was, with the principles of water control.

Ellen Churchilll Semple

A Medieval Persian Treatise on Geography

G. Le Strange, transl. **The Geographical Part of the Nuzhat-al-Qulūb composed by Ḥamd-Allāh Mustawfī of Qazwīn in 740 (1340).** xix and 322 pp.; index ("E. J. W. Gibb Memorial" Series, Vol. 23, Part II). E. J. Brill, Leyden; Luzac & Co., London, 1919. 8s. 9½ x 6½ inches.

Guy Le Strange has rendered a great service to students of the historical geography of the Near East by bringing out a critical edition of the Persian text together with an English translation of this important work. Western readers are now able to gain a clear and accurate idea of what is probably the most significant medieval Persian treatise on geography.

As a whole, the Nuzhat-al-Qulūb consists of an introduction on astronomy and mathematical geography, two non-geographical books, a third book on regional geography, and a conclusion on the marvels of Iran. (See G. Le Strange: Mesopotamia and Persia under the Mongols, in the Fourteenth Century A.D., *Asiatic Society Monographs*, Vol. 5, London, 1903, pp. 11 et sqq.) Much of the Nuzhat-al-Qulūb was translated by C. Barbier de Meynard in the notes to his "Dictionnaire . . . de la Perse" (Paris, 1861). Like most of the historical and geographical writings of the Orient, it lacks originality; as Le Strange states in his preface, "Ḥamd-Allāh quotes largely from older authorities, and in most cases we possess the texts which he used. However, in many of his accounts of towns and descriptions of provinces he has added something of his own, from personal observation, to what he has translated not very accurately from the Arabic texts." He "gives a graphic picture of the lands of Īran in the latter days of the Īl-Khāns" [Mongol rulers of Persia and Mesopotamia]. The wealth of topographic detail in the chapter on this part of the world is immense, and the account of Asia Minor "is unique and of unknown origin."

Furthermore, the Nuzhat cannot fail to appeal to whosoever is interested in the evolution of scientific and geographic knowledge as a whole. As an example of a type of medieval geographical treatise, this edition serves the same purpose for Persian that Reinaud's famous "Géographie d'Aboulféda" serves for Arabic geography, and we may well be sorry that Le Strange has not as yet seen fit to make the work complete in this respect by publishing a

translation of the introductory part on mathematical geography in addition to the regional chapters. Nevertheless, in the latter there are occasional striking passages. Chapter 16 (p. 180), for instance, begins with a clear exposition of the processes of erosion and the genesis of mountains:

"In philosophical works it is explained how, earth and water being mingled together, from the viscosity that is in the earth, the heat of the sun causes the same to harden, thus turning it to stone even as fire bakes the clay-brick. But the sun's heat then beginning to act on the stone, this loses its hardness and is broken up; which process continually accelerated by the succession of many nights and days cracks appear, splitting the rocks, which same are thus again turned to earth. Then by the action of earthquakes mountain peaks are demolished, while by the blowing of the winds and the running waters the soft earth is carried from one place to another, yet all that is rock and hard soil will remain fixed, whereby heights and hollows are formed, and it is these heights that are the mountain ranges."

In Chapter 18 (p. 200) there is an account of the origin of springs from rain water that contrasts very favorably with the fabulous hypotheses on this subject current in Europe at the time. There is not a little incidental weather and climate lore, and the cause of the tides in the "Seven Seas" is ascribed to the moon, although in the "Circumambient Ocean" Mustawfi believed in but one yearly tide, produced by the sun alone. Certainly Ḥamd-Allāh was not averse to recording in immense detail all kinds of geographic marvels and monstrosities, but they serve to set off rather than detract from the brilliance of those gems of accurate observation and precise thought that are embedded in the pages of this work.

The Population of India: Conditions and Tendencies According to Census Statistics

P. K. Wattal. **The Population Problem in India: A Census Study.** vii and 83 pp. Bennett, Coleman & Co., Ltd., Bombay, Calcutta, and London, 1916. 1 rupee. 8½ x 5½ inches.

The author—is he a native of India?—sees the population increasing faster than the means of subsistence and believes the only remedy is "voluntary restraint in married life." But of this he has no hope.

The two-thirds of the Indians who are Hindus have the economic misfortune to be required by their religion to marry and beget sons. For they take their religion seriously. All but four per cent of the women between 15 and 40 years are married or have been married. For all India the percentage is six, for the Mohammedans largely follow the example of their Hindu neighbors. In every thousand Mohammedan girls under five years of age five are married, among Hindus 18. In every thousand between five and ten years for Mohammedans 65 and for Hindus 132 are married. Between the ages 15 and 40, 860 of a thousand Hindu women and 837 of a thousand Mohammedans live in matrimony. Forty-seven per cent of the population is married, almost exactly eight per cent more than the United States.

The Indian birth rate of 39 in a thousand is one of the highest in the world. So is the death rate of 34. The poverty of the people is extreme. The loss of children by death is little lamented, provided it does not leave the family without sons. There is no emigration from the country to speak of, and so little migration that barely nine per cent of the population are enumerated away from their birthplace. Seventy per cent of them are engaged in agriculture on little holdings of an acre or so per capita. The number engaged in manufactures is falling off as factories become more numerous, for the machines introduced displace many more hand workers than they occupy. Indian industry is in the transition stage. The factory hands do not move to town with their families but leave the family on the land while they work in town, so that large towns like Bombay are apt to have a great disproportion of men in their population. These factory hands look forward to a return to the land. The town exercises no attraction on them apart for the high, steady wages. But, as the number employed is diminishing, industry cannot be said to be directly increasing the national means of support.

It has been said India has much waste land to reclaim, especially by new works of irrigation. Wattal questions this. He finds figures proposed by different writers both for and against. He thinks there is less available land than commonly reported, except in Assam and Burma, and that further irrigation is of nearly prohibitive cost.

Indians of all ages have far less expectation of life than Englishmen in England; worse still, the Indian expectation has been diminishing these twenty years while the Englishman's has been increasing. In 1911 an Indian 20 years of age had a life expectation of 27.5 years—one year less than he had in 1901. The Englishman of the same age in the same period had increased his expectation from 41 to 43.7 years.

It is a sad picture. Not all the census figures are sad though. One table shows wages in India between the years 1900 and 1912 rising from 119 to 166, while the average of prices had only risen from 122 to 141. In England in the same period wages rose from 100 to 103 and prices from 100 to 109. Wattal thinks this peculiar though he has no reason to doubt the figures. Another datum that troubles him is the number of people to a house. It has fallen during the last three decades from 5.8 to 5.4, 5.2, and 4.9. Surely that is a gain.

Another comforting fact that the author does not mention is that the census shows Indian population growing at the rate of 2,000,000 a year, 8,000,000 since the book was written, and still it has found subsistence. If the limit of food is near, surely there must be evidence on every hand in India that famines are more frequent and that life is harder than formerly: the author offers none.

However, his main point is beyond doubt. India has too high a birth rate.

Mark Jefferson

Town Planning in Ancient India

C. P. Venkatarama Ayyar. **Town Planning in Ancient Dekkan.** With an Introduction by Patrick Geddes. xxi and 199 pp. The Law Printing House, Madras. $2.00. 7 x 5 inches.

A collection of references to town and house construction in the old Tamil writings, with comments by the author. One can hardly say that old Dekkan did any town planning. There were some habitual features. Different arts and trades had streets to themselves. The elephant trainers had broad avenues to exercise their animals. The temple tended to be a central feature; and, except in river towns, there was an ample tank of drinking water containing sufficient water even if the monsoon failed. This was commonly bordered by trees and gardens, in which beauty was prized but "sanitation" was sought—in an oriental way. Punnai trees were planted by the seashore, because this tree grows "in sandy soil. Its smell keeps off the bad odours of fish." Trees bearing nutgalls were valued for planting alongside the water tanks because the tannin in their fruit gives a "slightly sweet taste to the water and thus masks any excess of chlorine in drinking water."

Mark Jefferson

Volcanoes of Eastern Bali

G. L. L. Kemmerling. **De Vulkanen Goenoeng Batoer en Goenoeng Agoeng op Bali.** Maps, diagrs., ills. *Jaarboek van het Mijnwezen in Nederl. Oost-Indië,* Vol. 46, 1917, Part I, pp. 50–77. Batavia.

Kemmerling's account of the two volcanoes on Bali is preceded by a study in the same yearbook (pp. 1–48) of a destructive earthquake by which the southern side of that beautiful island was visited in January, 1917. It may be here noted briefly that the earthquake had an undulatory motion and is ascribed, not to volcanic action, but to structural deformation between the up-raised chain of islands and the deep floor of the adjacent Indian Ocean. It is reported that 74,000 buildings, or 90 per cent of the total number, were overthrown or injured, 1,358 persons were killed, and 1,060 wounded. Great damage was done by landslides, of which a number of good views are given, in unconsolidated volcanic deposits on the sides of ravines and on the inner ring-wall slope of the Batur (Batoer) caldera.

Both the volcanoes described are in the eastern part of Bali. Gunung (Mount) Agung, or the Peak of Bali, is a fine young cone of regular form, 3,142 meters in altitude, with a summit crater ½ kilometer in diameter; the long exterior slopes, largely built of lavas, are little dissected. The Gunung Batur mass, farther west, is much more complex. It consists primarily of the remains of a great cone, the top of which has broken down to caldera form, but the caldera is now more or less filled with the products of later eruptions; the down-wash of recently erupted material from the exterior slopes of the remnant cone has largely contributed to the aggradation of the piedmont lowlands. The caldera bears the marks of two engulfments; the earlier one produced a ring wall of elliptical outline, 13.8 and 10 kilometers

in diameter, and varying in altitude from 1,267 to 1,745 meters, the highest point being on the north. The inward slope of the wall, probably much decreased by fragmental materials from later eruptions, leads by a gentle declivity to a caldera floor about 1,400 meters in altitude on the north but less on the south. The later engulfment produced a smaller circular caldera, 7 kilometers in diameter, in the floor of the earlier one; steep walls, 200 or 300 meters high and more or less ravined, separate the two. So much as now remains of the earlier floor, or Kintamani terrace, is of over-crescentic, or horseshoe, form, narrowest southwards, as the later caldera is somewhat excentric with relation to the earlier one.

Several good-sized cones were built after the breaking down of the original volcano. One of the earlier is Gunung Abang, which surmounts the western side of the main ring wall with a summit of 2,152 meters; its western slope is moderately ravined; its eastern side was broken down by the later sinking of the deeper caldera floor. Important later eruptions produced the confluent cones of Gunung Batur proper, consisting partly of lavas but more largely of fragmental materials, in the center of the later caldera: the higher cone to the north is 1,717 meters in altitude, the lower one, 1,589 meters; each cone has a crater, and each crater wall is highest on the north. The latest lava flow came from the lower cone in 1905 and now covers a southeastern part of the lower caldera floor; but a larger part of the floor, between the central Batur cones and the Abang halfcone on the west is occupied by a crescentic lake of deep blue or green color, which adds greatly to the beauty of the view from the ring wall and makes it one of the finest volcanic panoramas in the Archipelago. The lake surface is about 7 kilometers long by 2.5 kilometers wide and has an area of 15.5 square kilometers. The water is fresh although the lake has no visible outlet; its level rises somewhat during the southwest monsoon. Hot springs occur near the lake and are reported to be of medicinal value. The Batur cones are barren, but the caldera floor and rim wall have more or less vegetation and are in part populated and cultivated.

W. M. Davis

Land Forms of Northwestern Sumatra

W. F. F. Oppenoorth and J. Zwierzycki. **Geomorfologische en tektonische waarnemingen als bijdrage tot verklaring van de landschapsvormen van Noord-Sumatra.** Map, diagrs., ills. *Jaarboek van het Mijnwezen in Nederl. Oost-Indië,* Vol. 46, 1917, Part I, pp. 276–311. Batavia.

This essay is a by-product of governmental geological surveys in Atjeh, the northwesternmost province of Sumatra. The province is 370 kilometers long, northwest-southeast, and about 100 kilometers across, with a full-length coast to the southwest, a somewhat shorter east-west coast that truncates the end of the great island obliquely, and a short northeast coast. The boundary between Atjeh and the adjoining province runs irregularly a little east of north. The essay gives gratifying evidence that modern methods of physiographic analysis are applied by competent investigators in the Dutch East Indies in a thoroughly appreciative manner. Three subdivisions of the province are recognized: (1) The high mountains of the interior, composed of schists and bedded rocks with altitudes of from 1,400 to 2,800 meters and continued southeastward; (2) a bordering hilly belt of variable width, composed of more or less folded sedimentary strata, generally of small resistance; and (3) a low and narrow coastal plain. Volcanic features are irregularly distributed over the three subdivisions.

The late mature or aging forms of a former cycle of erosion are preserved in the highlands in the interior mountains, where rounded summits maintained by the more resistant rocks rise to moderate heights over broad high-level depressions which represent subsequent valleys following belts of weaker rocks; but in consequence of a central upheaval of about 1,000 meters the broad high-level depressions are now incised by deep, early-mature valleys, in which the main rivers are generally graded and have only occasional rapids. Waterfalls are, however, still retained in the upper courses of the side streams, which descend to the main valleys between hilly spurs, the flat tops of which record the present altitude of the former broad valley floors. The upheaval of the region decreases outwards from the central mountains, for the hilly belt has altitudes of only 400 meters next to the mountains and of about 50 meters near the coast. This movement increased the size of the original island by adding some of the adjoining sea bottom to it, especially on the northeast where the added belt is broadest and uninterrupted; it is narrowest on the southwest, where some of the mountains reach the coast in bold headlands. The strata of the hilly belt are chiefly clays

and marls, with occasional conglomerates; they are most folded and most eroded near the mountains, where subsequent valleys are developed along certain anticlinal axes; they are less folded and eroded near the coast, where structural arches and troughs are still expressed in the topography although the arches are well dissected by consequent streams and are cut across in antecedent fashion by the large rivers from the interior. The folded structure has been carefully studied, as some of these strata bear petroleum. Occasional hard beds form cuestas and ridges, but the strata are usually so weak as not to exhibit their folded structure in their surface forms. Here the soils creep and slide so readily down the slopes, especially in cleared districts and at times of heavy rains, that many valley floors are unevenly aggraded and converted into morasses, in which the streams are broken up and confused with the ground·water; such valley floors are used for rice culture. The larger valleys, in the mountains as well as in the surrounding hilly belt, exhibit along most of their length the effects of intermittent upheaval in well-defined but discontinuous terraces at two levels; the higher one from 90 to 120 meters, the lower one from 30 to 50 meters, over the rivers. Corresponding wave-cut terraces and wave-built beaches, associated with coral-reef patches and shell deposits, are seen along the outer slope of the hilly belt at heights of 100 and of 40 meters: the coral-reef patches grow up from gravel beds. Low terraces in the main valleys are attributed not to a revival of erosion in consequence of recent uplift but to river floods, although some of the rivers are still deepening their beds. The low coastal plain is from 3 to 30 kilometers wide and from 10 to 15 meters above sea level at its inner border; it is here and there extended by the growing deltas of the larger rivers and by the growing marshes of lagoons enclosed by offshore sand reefs.

Volcanic activity, long continued, has intermittently and unsystematically superposed various features upon the forms above described. Several great cones have been formed in the different areas; one of the largest, Geureudong, is a complex mass which rises over the interior mountains inland from the mid-length of the northern coast; it is broadly truncated at an altitude of 3,260 meters (as if it contained an extensive crater); one of its lateral cones bars the upper course of a river and thus forms Laut Tawar lake, formerly larger than now, but still some 25 kilometers in length. A similar lake in another valley, now drained, is recorded in shore terraces and deltas. Extensive mudflows of volcanic agglomerates and tuffs, from 10 to 50 kilometers in length, bury parts of the hilly belt or flood its valleys, thus more or less completely extinguishing its relief; but these flows are now dissected by narrow, steep-walled ravines with cascading streams. One of the volcanic cones forms the island of We, about 10 kilometers in diameter and 730 meters in height, near the northwestern extremity of Atjeh; it is described in a special article by Zwierzycki (*Jaarboek van het Mijnwezen*, Vol. 45, 1916, pp. 1–11) as of well-dissected form, bearing three wave-cut benches, at 20, 40, and over 100 meters above sea level; the middle bench is the most distinct; it girdles the island and sometimes has a width of 150 meters. Remains of "coral banks" are found on each bench.

The photographic illustrations of the essay on Atjeh are fair; the outline figures in the text might be much better. The physiographic analysis bears every mark of accuracy; but, as it is the work of geologists, it is naturally given a geological phrasing which is avoided as far as possible in the above abstract.

W. M. Davis

Climate and Weather of the Philippines

José Coronas. **The Climate and Weather of the Philippines, 1903 to 1918.** 195 pp.; maps, diagrs. The Government of the Philippine Islands, Philippine Census, A. D. 1918. Bureau of Printing, Manila, 1920. 9 x 6 inches.

Several important studies of the climate of the Philippines have been issued during the past two decades. An extended discussion entitled "Climatología de Filipinas" (1899) was published as a part of "El Archipiélago Filipino," printed in Washington at the expense of the United States Government. An English translation appeared in Volume 4 of the Report of the First Philippine Commission to the President (1901, pp. 113–357). A summary was published in 1900 under the title "Interesting Climatological Data Concerning the Weather of Manila." To the 1903 Census of the Philippines, Rev. José Algué, S.J., Director of the Weather Bureau, contributed another report on climate, which included many of the illustrations and tables of the monograph embodied in "El Archipiélago Filipino," but revised to date. To Father Algué we are also indebted for two pamphlets on the climate of Baguio (1902, 1909). The rainfall has been discussed by Rev. Miguel Saderra

Masó, in "The Rainfall in Philippines" (1907) and "Annual Amount and Distribution of Rainfall in the Philippines" (1914). In 1915, as a contribution to the Panama Pacific International Exposition, Rev. José Algué issued a pamphlet showing, on a map, three types of climate based on the monthly distribution of the rainfall and considered the characteristics of each type.

The present monograph is a new and original study, prepared for the Philippine Census of 1918. It is not only remarkably complete in all details, including many which are often omitted in climatic discussions, but it also lays special emphasis upon the weather conditions. Climate being average weather, a knowledge of the weather types which, taken together, go to make up any climate, seems to us absolutely essential. In climatological progress of the last decade, one of the most marked tendencies has been the increasing emphasis laid upon the weather element, with the result that recent studies have given far more complete, vivid, accurate, and withal interesting pictures of the climates with which they deal than was formerly the case.

This Report presents more data and deals with more stations than any previously published on the climate of the Philippines. Special emphasis is laid on rainfall, which is the most critical element of the climate in a region whose temperatures do not vary widely. The types of monthly distribution of rainfall are shown by means of a series of curves, and an interesting "climate map" indicates, by colors, the two main and the two intermediate types of rain distribution. On this map a novel and ingenious method of showing the annual amounts of rainfall is employed. These amounts are entered, for each station, in very legible figures, in color according to the amounts, the four colors used indicating rainfalls of under 1,500 mms., 1,500–2,000 mms., 2,000–3,000 mms., and over 3,000 mms. The resulting map presents the facts of annual rainfall and of rainfall types in a singularly clear and effective manner. On a somewhat similar scheme, the essential temperatures are shown. At each station there are three sets of figures, printed in a column. The first is the mean annual minimum; the second (in red) the annual normal; and the third the mean annual maximum. This map shows the temperatures very simply and clearly.

The typhoons which affected the islands during the period of 16 years are distributed by provinces and subprovinces, the tracks of remarkable typhoons being plotted. Accounts are given of all the principal floods and periods of drought experienced during the period. A page of curves of monthly mean temperatures for selected stations in Europe, the United States, and the Far East illustrates the steadiness and small ranges of the temperature in the islands. Several wind roses show the seasonal changes in wind direction, and bring out clearly the monsoon tendencies.

This new and interesting report will be welcomed as one of the important publications on climatography of the last dozen years. We commend it as a model of what a climatographic discussion should aim to be.

R. De C. Ward

An Ethnographic Handbook on the Philippines

A. L. Kroeber. **Peoples of the Philippines.** 224 pp.; maps, ills., bibliogr., index. (Amer. Museum of Nat. Hist. Handbook Ser. No. 8.) New York, 1919. 8 x 5½ inches.

This volume of the admirable Handbook Series of the American Museum is the fourth dealing with primitive races. The first three treated of restricted culture areas in North America, while the present volume deals with an area of entirely different character.

As the introduction points out, the Philippines present a field of exceptional interest to the student of the development of social culture inasmuch as they preserve a remarkable "stratification" of civilizations. The most recent "layer" includes the religious and cultural features of the Christian epoch dating from the Spanish conquest of the Islands in the later sixteenth century. Mohammedanism came two centuries earlier and still maintains its sway in the southernmost parts of the island group. More profound are the influences material and spiritual that, emanating from India, spread throughout the East Indies and probably reached the Philippines mainly by native channels of transmission. Contemporaneously there were relations with southern China, apparently on the material side alone. "There is not a single institution, piece of knowledge, or religious belief current in the Philippines that can be derived with any certainty from China." Below these is the stratum of primitive Malayan culture, and there are remnants of the still earlier culture known as Negrito.

Dr. Kroeber gives an illuminating exposition of the principal facts regarding the native

civilizations and the racial and linguistic characteristics of the Philippine peoples, placing the whole in an adequate geographical setting. The paragraphs on population density and distribution (accompanied with map based on the census of 1903) are specially interesting.

Population even in pre-European times was comparatively dense. The lowest computation gives five per square mile, a figure greater than that for any parts of the aboriginal New World except parts of Mexico and Peru. Under Spanish rule population increased in the main because of removal of social causes militating against increase—piracy, human sacrifice, head hunting, etc. Comparatively little was done to render more land available for cultivation or to improve the yield from cultivated areas. The possibilities in these latter directions are enormous. The subprovince of Ifugao in the interior of northern Luzon, with an area of some 750 square miles of which less than 50 square miles are actually cultivated, is estimated to contain 132,000 inhabitants. This means that more than 2,000 people are supported by each square mile of cultivated land—a density rendered possible by the skilled works of terracing and irrigation that are astonishing achievements for so distinctly primitive a tribe as the Ifugao.

Vegetational Studies on Philippine Mountains

William H. Brown. **Vegetation of Philippine Mountains: The Relation Between the Environment and Physical Types at Different Altitudes.** 434 pp.; map, diagrs., ills., index. *Manila Bur. of Science Publ. No. 13*, Manila, P. I., 1919. 9½ x 6 inches.

As the title implies, this is an attempt to relate the vegetation of different altitudes to the environment by measurement of the various climatic and soil factors. Most of the study is devoted to Mt. Maquiling, an isolated extinct volcano, 1,140 meters high, situated 64 kilometers southeast of Manila. A briefer study was also made on Mt. Banahao, 2,300 meters (pp. 391–405).

The vegetation of the slopes of Mt. Maquiling is divided into four types as follows: (1) *parang*, a Tagalog term for mixture of second-growth forests and grassland in early stages of recovery from former clearings, around the base of the mountain and extending up the slopes to an altitude of 200 meters; (2) dipterocarp forest, from the edge of the *parang* to an altitude of 600 meters; (3) mid-mountain forest, from 600 meters to 900 meters; and (4) mossy forest, on the top of the mountain and bathed in clouds for a large part of the time. A general description is given of each one of the vertical zones of vegetation.

Small plots, usually .25 hectare in area, are laid out, and a census of the vegetal population is taken. In this census, probably the most complete ever taken in a tropical forest, the well-known arrangement of the forest into stories is recognized, and the number of tree species of each story is recorded. For instance in the dipterocarp forests three stories are thus enumerated. The height of the tree, its diameter, and the length of the bole are measured; and from these data the volume of the wood is obtained. These figures show that, while the plot contains 92 species, only a few of them have the capacity to reach, when mature, the upper story, making it comparatively simple in composition. This is a confirmation of the investigation of the writer of this review made in tropical forests of both hemispheres and is of great importance from the standpoint of the lumberman, for trees of the upper story are usually the only ones of sufficient size to utilize on a large scale.

As one ascends any tropical mountain, it will be noticed that the height of the forest and the number of stories diminish. Brown's measurements show that in the dipterocarp forests (three stories) the tallest tree is about 40 meters and the average height of the top story is 27 meters; in the mid-mountain forest (two stories) the tallest tree of the first story is 22 meters and the average height is near 17 meters; while in the mossy forest (one story) the tallest tree is 13 meters and the average height is about 6 meters.

In order to explain, if possible, the interrelations of the different classes of vegetation at the same and at different altitudes extensive measurements of the environmental factors were made at five stations at different altitudes. In this way comprehensive data, more complete than ever before undertaken in any tropical country, were obtained of the temperature, light intensity, rainfall, soil moisture, humidity, evaporation, and wind velocity. In some instances instruments in the same station were set up at different heights from the ground, thus giving data concerning the local climate in different layers of the atmosphere. The readings extended over a period of some two years.

Some of these results may be briefly indicated. As one would suppose, the temperature decreases from the lower altitudes to the higher. The average daily maximum is as follows: at 80 meters, 29.2° C.; 300 meters, 25.1° C.; 450 meters, 24.3° C.; 740 meters, 23° C.; 1,050 meters, 19.3° C. Owing principally to more frequent cloudiness at the higher altitudes the light intensity decreases from the base of the mountain to the top. The average daily light intensity in tops of dominant trees at different elevations, as measured by the difference between the evaporation from the white and from the black Livingston atmometer, is as follows: at 80 meters, 6.4; 300 meters, 5.9; 450 meters 5.1; 740 meters, 4.; 1,050 meters, 2.8. These figures show that the light intensity is 2.3 times as great at the base as at the top. The rates of growth and the heights of the trees at different elevations show a general agreement with the light-temperature indices; viz., with the product of light intensity multiplied by temperature indices for growth. In fact, Brown thinks that the lower temperatures and the lower light are the main factors in producing the lower growth of the higher altitudes. Of these the diminished light of the higher altitudes of Mt. Maquiling has, according to the author, the most influence; for the differences in temperature are not great enough to have an appreciable effect. Rainfall is greatest at the middle elevations, while evaporation decreases with altitudinal increase. The moisture content of the soil increases with altitude. At the base it is low enough to become harmful for vegetation.

The article is full of interesting discussions, sometimes speculative, although always based on some data and admitting that the conclusions reached must be verified by further studies. The quantitative description of the vegetation and the measurement of the different factors of the habitat are so exhaustive as to leave no doubt that the work has been well done. The records are all published in great detail; for, as the author states, "it is believed they will be of value in presenting an actual picture of environmental conditions, and they may be of service in the future in interpreting the relation of environment to different types of tropical vegetation in a more exact manner than is now possible"

H. N. Whitford

Nature and Man on Cape Cod

A. P. Brigham. **Cape Cod and the Old Colony.** xi and 284 pp.; maps, diagrs., ills., index. G. P. Putnam's Sons, New York and London, 1920. $3.50. 8 x 5½ inches.

Professor Brigham states that his object in writing the story of Cape Cod and the Old Colony was to show "the way men have used these lands and waters and come under their influence," to show "how the first colonists and those who followed them have adjusted themselves to the mobile conditions of nature and of man." This object he has accomplished acceptably, within the limits imposed by space and by the popular audience for which he has written. The physical history of the Cape, with its moraines and outwash plain, its dunes and lakes, its varied and ever changing shore line; the coming of the Pilgrims and the gradual extension of settlements around the Bay; and the changing relations of the people to land and sea through three full centuries—all are woven into a story told in a simple and charming manner for the general reader. Professor Brigham frankly admits that "the Cape cast its spell upon him." Its splendid views, its superb summer air, and its friendly people naturally appealed powerfully to such a lover of nature and of worthy men. And so he is always "sympathetic," perhaps at times unduly so, in his consideration of the activities, character, and outlook of the people of the Cape.

The early colonists were farmers; though most of their settlements were located upon the shores of harbors for purposes of communication and trade, they looked chiefly to the soil for a living, securing for a time good crops of corn and other grains. Where practicable they planted their gardens and fruit trees in the valleys, behind hills, or in kettle holes, as a protection against the ocean winds. Presently, however, agriculture lost its dominance in the economic life of the region, and it continued to decline through many years. Though "too much has been said about the poverty of the Cape soils," it is apparent that from the outset they were relatively poor in many places, and in spite of the use of marine fertilizers their yields decreased because of continuous cropping and of increased wind erosion consequent upon the removal of much of the scanty forest. Other occupations paid better than farming; and, as the population increased, more and more of the people turned to the sea. Increasingly in later years the Cape looked for its food supplies to the interior, with whose rich lands it could not compete in the production of staple crops. Many farmers moved to the prairies, and of late less than a fifth of the Cape has been in farms.

The earlier decline of agriculture and the growth of maritime activities were concomitant processes. The shore villages became thriving communities, whose fishing smacks gathered in the harvest of the offshore waters, whose whalers extended their operations even to polar regions, and whose merchantmen visited the ports of every sea. But in time the decline of these sea interests set in; for various reasons fishing has become of slight importance, whaling has ceased, and commerce has sought deeper harbors with better connections inland. As a result emigration increased, and the population of the Cape diminished until in 1910 it was less than in 1830.

Forced after many years to turn again to the land, the reduced population of the Cape has in later days found profitable employment in ministering to the needs of summer visitors and in growing special crops, particularly small fruits, suited to the climate and soil. The future prosperity of the Cape apparently will depend largely on its scenery and its summer climate, "on the summer boarder and the summer homemaker."

The reader unfamiliar with the Cape will wish that a more helpful map than that at page 24 had been provided. It is not easy to read, no scale is indicated, and many places and features mentioned in the text are not shown or are not named. [Compare the map illustrating Professor Brigham's article "Cape Cod and the Old Colony" in the July, 1920, number of the *Geographical Review*.] While there are many allusions to a few well-known sources of information about the Cape, definite citations are almost wholly lacking. If footnote citations are inappropriate in a book of this kind, a note on sources at the end would have been valuable to serious readers. The failure of the Cape ever to develop important manufacturing interests (other than salt-making from sea water), in spite of its proximity to the great industrial region of New England, is emphasized but inadequately explained. One feels that Plymouth receives scant attention after the account of the landing of the Pilgrims, and occasionally one is in danger of losing interest in the minute descriptions of places. It is safe to say, however, that few will read the book without resolving to visit or revisit this historic ground.

HARLAN H. BARROWS

THE CZECH ELEMENT IN THE UNITED STATES

THOMAS ČAPEK. **The Czechs (Bohemians) in America: A Study of their National, Cultural, Political, Social, Economic, and Religious Life.** xix and 294 pp.; maps, ills., bibliogr., index. Houghton Mifflin Co., Boston and New York, 1920. 8½ x 5½ inches.

The title of this study inevitably arouses comparison with its well-known precursor, Faust's "German Element in America," and unfortunately so, for it is not the epoch-making work that Faust's was. This is not altogether the author's fault, for his subject is less broad and more recent than that of the pioneer in the field of racial group cross sections of American life. Czech immigration as a significant factor in the social life of the United States is a matter of the last eighty years, and the number of immigrants and their descendants is relatively small even now. Granted that mere numbers do not measure the moral weight of a community, the other factors are nevertheless so intangible as to be difficult of evaluation without a perspective furnished by lapse of time. For these reasons the study is clouded by a multitude of personalities and of inconsequent details which partly obscure its conclusions.

This does not, however, deny value to the work. On the contrary, it represents a faithful and sympathetic portrayal of the most intimate details of Czech life in the United States from the days of the first immigrants. To an individual of Czech ancestry it will be a loving reminder of heroic days; to the general student of conditions in the United States it will serve as a source book for certain social origins of interest to the historian, the sociologist, the economist, the theologian, and the geographer.

Leaving aside points of interest to other general or special students, the geographer will find here and there useful facts or significant statements. Chapter 3 is devoted to the causes of emigration and of immigration during the two decades after 1840. The routes followed from the old land to the new and the reasons for selecting this or that place within the United States as sites for future homes, are traced with care and afford a basis for generalizing on the relative importance of geographic and non-geographic factors in determining these important steps of the immigrant. The principal contribution of the book to the field of geography is its study of the distribution of the Czech stock within the United

States. Chapter 4 is a tabular résumé of population statistics, illustrated with a dot map; Chapter 5 makes scattering additions to this fund of geographic information in a study of the distribution of the stock by trades; Chapter 17 recites the distribution of churches and churchgoers. Together these sections furnish a basis for comparison with similar data on other races. A comparative study of the distribution of immigrant races within the United States would be invaluable.

Not the least worth-while section of the book is the appendix, a bibliography of printed material on the Czech in America.

D. L. Whittlesey

Chapters in the Earlier Colonial History of Louisiana

N. M. M. Surrey. **The Commerce of Louisiana During the French Régime, 1699–1763.** 476 pp.; maps, diagrs., bibliogr. (Columbia Univ. Studies in Hist., Econ., and Public Law, Vol. 71, No. 1.) Columbia University, Longmans, Green & Cc., Agents, New York, 1916. $3.50. 10 x 6 inches.

This extended account of the commerce of Louisiana during the French period will be of value to students of the historical geography of the United States, for it is the first systematic discussion of all branches of that commerce and is based largely on unpublished documents. In Chapter 1 Dr. Surrey briefly outlines the exploration and settlement of the interior by the French. In Chapters 2 to 6 she notes the river routes and portage paths of the region, depicts the difficulties and methods of navigating the rivers, describes the various types of boats used, and considers the principal land routes, most of which had served as buffalo paths or Indian trails. Chapters 7 to 11 are devoted to "commercial processes," especially to the method of barter always used in the Indian trade, and to the rôle of silver, copper, and paper money and of credit in the other trade. The remaining chapters of the book (12 to 25) describe the trade between Louisiana and France, the slave trade, the domestic trade of lower Louisiana, the trade of the Illinois country, the fur trade (as developed by the French of Canada and the English of the eastern seaboard as well as by the settlers of Louisiana), and the less important trade of Louisiana with the French West Indies, Mexico, New Mexico, Texas, Florida, and Cuba, and with the English.

The non-geographic factors affecting these various branches of the trade of Louisiana are set forth in much detail, as are the facts concerning fluctuations in the prices of commodities, changes in the fortunes of rival traders, and similar matters. But the author ignores or recognizes inadequately many of the geographic conditions which influenced the development of the trade. Thus, in the pages devoted to the bitter rivalry between the French and the English for control of the fur trade of the lower lake region and the Ohio basin, one looks in vain for adequate recognition of the importance (1) of the relations of the St. Lawrence lowland and the Hudson-Mohawk depression as rival routes from the seaboard to the northern interior and (2) of the relations of various tributaries of the Ohio River to east-flowing, antecedent rivers of the Appalachians as affecting the western operations of the traders of Pennsylvania and Virginia. So obvious an influence in the trade of the Mississippi River as that of climate in differentiating the agricultural products of lower Louisiana and the Illinois country is ignored. Though a chapter is devoted to waterways and another to exploration and settlement, the outstanding facts (1) that the waterways made possible the rapid exploration of the interior by the French and largely determined the lines of their advance and (2) that the geography of the waterways fixed the location of most of their trading posts, are not made clear.

Maps showing the location of the French posts noted in the text, of the portage paths enumerated, and of the many Indian tribes referred to, as well as an index, would have added much to the usableness of the book. On a crude map showing the approximate courses of certain trails, Detroit is located on the site of Port Huron, Fort Malden is represented as at the mouth of the St. Clair River, Danville appears in Indiana, and Peoria has been shifted to the eastern side of the Illinois River, while similar liberties have been taken with other posts and towns. The reviewer long has wondered when the fraternity of historians will recognize the importance of providing and effectively using maps, accurate maps, in historical works.

Dr. Surrey says in the preface, "In elaborating the theme an effort has been made to bring together all that is pertinent and available in French and English records." In view of this painstaking search for data, one is surprised to find no reference in the bibliography

or the footnotes to such studies as Turner's "Character and Influence of the Indian Trade in Wisconsin," Quaife's "Chicago and the Old Northwest," Hanna's "Wilderness Trail," or Alvord and Bidgood's "First Explorations of the Trans-Allegheny Region," the more so as such a doubtful authority as Parrish's "Historic Illinois" is cited several times. Dr. Surrey has, nevertheless, brought together a multitude of useful facts, most of them not readily available elsewhere, which no future student of early Louisiana can afford to ignore.

Marc de Villiers. **A History of the Foundation of New Orleans (1717–1722)** Transl. from the French by Warrington Dawson. Maps, ills. *Louisiana Hist. Quart.* Vol. 3, 1920, No. 2, pp. 157–251.

The history of New Orleans may be said to commence with the year 1702 when De Remonville proposed the creation of a post at the "Mississippi Portage" (i.e. from Lake Pontchartrain). The date of the foundation "may be fixed at pleasure anywhere between the spring of 1717 and the month of June, 1722," the latter date following the decision that raised the town to the rank of capital. The vicissitudes of these years, which include the great flood of 1719, are here recounted.

Guides to the West Indies

F. A. Ober. **A Guide to the West Indies, Bermuda, and Panama.** 3rd revised edit. ix and 533 pp.; maps, ills., index. Dodd, Mead & Co., New York, 1920. $3.50. 7 x 4½ inches.

K. J. Burdon. **A Handbook of St. Kitts-Nevis, a Presidency of the Leeward Islands Colony, Containing Information for Residents and Visitors Concerning the Islands of St. Christopher or St. Kitts, Nevis, and Anguilla.** viii and 247 pp.; maps, ills., index. The West India Committee, London, 1920. 7 x 5 inches.

"A Guide to the West Indies, Bermuda, and Panama [the Canal Zone]," first published in 1908, is here brought up to date. For the tourist it is a comprehensive and useful volume. It might, however, be improved by the inclusion of more and better maps.

The handbook on St. Christopher (St. Kitts), Nevis, and Anguilla, which islands together constitute a Presidency of the Federal Colony of the Leeward Islands, is written by the wife of the present administrator. Mrs. Burdon has made good use of her opportunities to bring together in convenient form a large body of miscellaneous information useful to the traveler and in places suggestive to the geographer. Though small, the islands (area 155 square miles) have had an interesting and varied history; and this is described at some length. There are separate maps of the islands on the scale of 2 miles to the inch, and there is a reproduction of the "oldest known map of St. Kitts."

The Vegetation of Paraguay

R. Chodat. **La végétation du Paraguay: Résultats scientifiques d'une mission botanique suisse au Paraguay.** In collaboration with W. Vischer. Vol. 1, 157 pp.; map, ills.; Vol. 2, pp. 158–290; ills. Imprimerie Jent, Geneva, 1916, 1917. 9½ x 6½ inches.

Because so little is known as yet about the general vegetative features of Paraguay, anything that will throw light on the subject is welcome to the ecologist and the plant geographer. While the recent publication of Chodat helps to some extent in giving glimpses of the vegetation of this country, it falls short of containing a comprehensive view of the general vegetative features. In a brief introductory chapter on climatology and physical geography there is an attempt to relate the vegetation to these two groups of factors, accompanied by a small sketch map of that part of the country east of the Paraguay River showing inadequately, except for limited areas, the physical features. This map does not show the vegetative types accompanying such features. From the text it is gathered that, generally speaking, the country is divided into two physical types, the low more or less swampy lands occupying the Paraguay portion of the Gran Chaco region west of the Paraguay River and in places as belts of greater or less extent on the western side of the river. This type has a vegetation similar to that of the Gran Chaco region of Argentina. The rest of the

country is a dissected plateau, with a more or less continuous range of comparatively low mountains stretching from north to south and dividing the country into two unequal parts, the Paraguay and Paraná drainage regions. This plateau, according to the author, lowers gradually from the north to the south; at Punta-Pona near the northeastern corner it is 660 meters above sea level. At Ipé Hu it is 420 meters; at Caaguazú near the center it is 300 meters; and at Encarnación in the southeastern corner, at the big bend of the Paraná River, it is 120 meters.

The plateau region contains a subtropical rain forest generally speaking; that to the east of the divide is better developed than that to the west, but both forested regions are interrupted by grasslands and savana forests. The main part of the report deals with autecological rather than synecological problems; that is the species are treated as individuals rather than in communities. The publication is well illustrated with pen sketches and reproductions from photographs, which give one a better idea of the vegetation than the text; and with numerous drawings of the microscopic features of the plant tissues. Some new species are described.

H. N. Whitford

An Important Contribution to the Geography of Arctic Alaska

E. deK. Leffingwell. **The Canning River Region, Northern Alaska.** With a preface by A. H. Brooks. 251 pp.; maps, diagrs., ills., bibliogr., index. *U. S. Geol. Survey Professional Paper 109*, Washington, D. C., 1919. 11½ x 9 inches.

The region that Mr. Leffingwell describes lies on the northern coast of Alaska facing the Arctic Ocean and about 60 miles west of the International Boundary. A more bleak or inhospitable place could hardly be imagined, but the author must have been actuated by a great love of arctic nature for he kept going back to the region time after time, so that during the ten years between 1905 and 1915 he spent six winters and nine summers there, and all at his own expense. His work and observations covered a very wide range. He made a reconnaissance, a topographical and geological map of a rectangle 70 miles square, and examined the geological structure; he made a map of the coast line for 300 miles, along one-half of which he carried a network of triangles; he determined his latitude with a probable error of a fraction of a second and his longitude by lunar occultations with a probable error of 7 seconds. He made soundings through the ice to a distance of about 100 miles from shore; the continental shelf extended out about 50 miles, and there he found a sudden change of depth from 30 to 320 fathoms in a distance of 2½ miles. Beyond this his line of 320 fathoms found no bottom. Captain Mikkelsen, who was with him the first year, made careful tidal observations; and Mr. Harris, of the U. S. Coast and Geodetic Survey, found that they supported the idea of extensive land in the Arctic Ocean to the north. This land has never been seen, but we must remember that the region where it is supposed to be has not been explored.

Mr. Leffingwell tells us of the climate and of the animal life and gives a long discussion of the ground ice; but let us summarize some of his results.

The region he studied partially bridges the gap between the region examined by the geologists of the International Boundary Survey on the east and that examined by the geologists of the U. S. Geological Survey on the west. All these studies show that the general structure of northern Alaska trends about east and west and is fairly continuous from the International Boundary to Cape Lisburne. Topographically the Endicott Mountains form the watershed between the Yukon River and the Arctic Ocean; the range is known under special names in its different parts. North of this is a piedmont plateau and then a coastal plain. In the region examined by Mr. Leffingwell these three provinces are separated by scarps which give the appearance of faults, but which in places may be steep folds. The main mountain range is made up of strongly folded schists of pre-Carboniferous age with some igneous intrusives. It rises to a general height of about 6,000 feet, with a few peaks as high as 9,000. The higher parts are covered with snow giving rise to numerous glaciers. These, however, could not be explored, but, according to Mr. Leffingwell's pictures and descriptions, they have no peculiar characteristics. In front of the Endicott Mountains, between the Canning and Okpilak Rivers, are three mountain ridges made up of folded Carboniferous limestones and sandstones, with gentle slopes towards the south and steep slopes to the north; their surfaces seem structural; they strongly suggest tilted blocks. They end abruptly, their folds apparently plunging down at both ends. In front of the

mountains the piedmont plateau, but little dissected, consists of upturned and planed-off Mesozoic and Tertiary strata; and the coastal plain down to the ocean is a flat featureless plain of very recent deposits. The rivers are parallel and closely spaced, all flowing across mountains, plateau, and plain to the Arctic Ocean; they give the impression of simple subsequent streams, though their origin is not entirely clear. There seems to have been no deformation of the region at the end of the Paleozoic; but since Jurassic or Cretaceous times, and to the end of the Tertiary, it has suffered many disturbances with more or less peneplanation in between.

The description of the general erosion of the region and of the formation of sand bars and spits along the coast, etc., indicates no material difference from temperate regions; but in the frozen ground of the tundra we find a phenomenon peculiar to the far north.

The subject of ground ice and frozen ground is treated very fully. The observations of previous writers are summed up and largely quoted. Middendorff's studies of the Schergin shaft in Siberia, which are not easily accessible, are given in some detail. This shaft was sunk at Yakutsk, Siberia, in the early part of the last century with the hope of finding water for the town, but it did not penetrate below the frozen ground even at a depth of 382 feet. In 1844–1846 Middendorff made extensive observations on the temperature in the wall of the shaft at various depths below the earth's surface. The general result showed a temperature gradient which flattened out with depth and seemed to indicate, by its steeper gradient near the surface, that the mean annual temperature of Yakutsk had been recently lowered by nearly 5° C. at the time of Middendorff's observations. In Alaska several shafts have been sunk about 200 feet, and one reached 365 feet, without penetrating below the frozen ground. Various theories as to the origin of this condition are discussed, and the attempt is made to determine the age from the temperature gradient; but with little success, for much detailed data are needed which are not available. Nevertheless the attempt is interesting and may sometime yield more definite results. The "ground ice wedge" is an interesting form which is apparently widespread in the northern tundra. The ice occurs in the form of wedges very free from mixture of earth. They are ten or twenty feet across at the top, a few feet below the surface of the muck, and narrow out below, apparently disappearing at a depth of twenty or thirty feet. The author connects them with the frost cracks which form with loud reports in the ground during the great cold of winter; later, water flows into these cracks and freezes; and, as the whole warms up during the summer, the expansion squeezes up the sand and clay on the sides and so produces a slightly uneven land surface broken into polygonal blocks, the frost cracks occupying the depressions between them. This process continues year after year, and the ice wedges grow in size.

Many details and interesting descriptions of ground ice, sea ice, and ice formed by the rivers and domed up under hydraulic pressure are given; but they must be passed over with a mere reference.

The difficulties Mr. Leffingwell encountered were serious. In summer he had to be his own pack horse, which interfered greatly with his excursions into the mountains; in winter, when journeys could be taken by sleds, the snow covered much that he wanted to see. One must admire the energy and enthusiasm with which he stuck to his purpose, going back year after year, improving and broadening his observations in the face of many obstacles. It is by just such persevering work as his that knowledge of the difficultly accessible regions of the earth is becoming definite.

Harry Fielding Reid

A Textbook of Australian Meteorology

Griffith Taylor. **Australian Meteorology: A Text-Book including Sections on Aviation and Climatology.** xi and 312 pp.; maps, diagrs., index. Clarendon Press, Oxford, 1920. $5.65. 8½ x 5½ inches.

Meteorologists the world over will welcome this excellent book which throughout is characterized by that originality and stimulation with which the readers of the *Geographical Review* are already familiar in Dr. Taylor's contributions. The work is primarily intended as a general textbook for students of meteorology and climatology in Australia, but, unlike most textbook writers, Dr. Taylor has written for foreign readers quite as much as for those at home. There are many valuable suggestions to the teacher, particularly on the advantage of using Australia as a climatic model to show the temperature and rainfall effects of the seasonal migrations of the sun, and, in turn, the control of the resulting climates over the

industries and distribution of population in Australia. Principles therein discovered could then be applied to the more complex climatic environments of other parts of the world. For such a comparative purpose the book is well fitted. Thus, in discussing climatology Australian homoclimes, *i.e.* the climates, products, and types of people in corresponding climates elsewhere, are cited. A world map of Herbertson's natural regions revised for Australia is presented. This chapter is admirable as an essay on comparative human climatology. Many of its interesting points are discussed more fully in the article "Agricultural Climatology of Australia" of which an abstract is given elsewhere in this number of the *Review.*

Of considerable interest also are the chapter on "Aviation and Meteorology," based largely on his own and his aviator-students' experiences, and that on "The Origin of the Tropical Lows in Australia." The low-pressure areas here dealt with form as buds from the two foci of practically permanent low pressure in summer in northern Australia. Dr. Taylor thinks that broad "convection domes" of heated air build up over these regions and from time to time have their summits torn off by the northwest anti-trades aloft and that these warm masses, having been given an eddying motion while being detached, reduce the pressure in the strata below and thus bring about the establishment of separate cyclones. He thinks that this convection-dome theory is also adequate to explain the origin of those extra-tropical cyclones which bud off from the other major centers of convection of the world, *i. e.* the low-pressure "centers of action."

There are few portions of the book open to adverse criticism. As in most textbooks on meteorology, the chapter on clouds and their origin is unsatisfactory, chiefly because of its brevity. In explaining how clouds originate, the common method, by mixture, is not even mentioned.

Two appendixes show the "Topographic Control of Rain in S. E. Australia" and "Temperature and Rainfall Averages for Australian Towns." In the front cover is a workable solar-control model; at the end a full index. Illustrations to the number of 229, most of them drawn by the author, vivify the text.

Charles F. Brooks

Papers on the Tides

W. B. Dawson. **The Tides and Tidal Streams, with Illustrative Examples from Canadian Waters.** 43 pp.; diagrs., ills. Dept. of the Naval Service, Ottawa, Canada, 1920. 9½ x 6½ inches.

W. B. Dawson. **Tidal Investigations: Results Deducible from the Tidal Observations.** Map. (Rept. of the Canadian Arctic Expedition, 1913–18, Vol. 10, Part C, pp. 3B–13 B.) Ottawa, 1920.

The first named paper treats the subject in a somewhat popular manner. It embraces the tide in general; the methods employed in the observations of tides and description of tidal curves; the causes of the tides; types of tides; the tides as modified by local conditions; and tidal streams as illustrated by Canadian examples. Attached to the paper are five plates illustrating the several types of tides as represented by observations at Canadian tidal stations.

Because of the scarcity of publications in English dealing with the subject of tides and tidal phenomena from the viewpoint of the layman, the present pamphlet is welcome. It is questionable, however, whether the treatment of the movements of sun and moon is not too detailed for the layman, and a like question might be raised as to the author's description of the types of tides. Furthermore, in describing tides he classifies them into three types—the synodic, the anomalistic, and the declinational. It is not certain that this classification will appear as clear to the layman as that of daily, semidaily, and mixed types.

The author calls attention to the scarcity of material dealing with the effect of wind on surface currents. In the observations made on currents in Canadian waters, where the tidal currents are generally of considerable magnitude, the current due to the wind is necessarily masked by the strong tidal effects. From this the impression might be gained that the effect of the wind in general is negligible; while, as a matter of fact, in localities where tidal currents are weak the current will generally set with the wind masking entirely the tidal effect.

The second paper covers the tidal investigations and results of the expedition (1914–1916) under the leadership of Mr. Vilhjalmur Stefansson.

Tidal observations in the Arctic regions have a value not only in extending our knowledge of the geographic distribution of the tides but also in helping to throw light on the theory of the existence of a large land mass in the Arctic, a deduction which was arrived at from scanty tidal observations.

The paper gives a concise report of the methods and results of tidal observations at ten places in the general region of Beaufort Sea, where tidal observations at best are meager, and is a welcome addition to the tidal literature of the Arctic. An appendix gives mean ranges and establishments and a map of the region showing the location of the tide gauges.

The report brings out the importance of accurate time for proper comparisons with other stations and in this respect will be valuable for the Arctic explorer, whose tidal observations are only incidental to the many varied subjects to which he must give attention. It is shown that, on account of the small range of the Arctic tides, observations should be made when possible at the time of spring tides and further that, with regard to general procedure in any future tidal observations in the Arctic regions, some permanent tidal station should be established for reference in the region and should be maintained during the time the explorations are in progress.

G. T. Rude

Topographic Determinants of Artillery Operations

W. C. Clark, compiler. **Heavy (Coast) Artillery: Orientation.** Revised. xv and 302 pp.; maps, diagrs., ills., bibliogr. Coast Artillery School, Fort Monroe, Va. 75 cents. 9 x 6 inches.

Batteries of heavy artillery are usually located several miles behind an army's front line and direct their fire at targets which are not visible from the gun positions. Under these conditions the fire must be controlled by precise topographic methods and based on accurate, large-scale topographic maps. The procedure of making the topographic determinations necessary for map firing is called *orientation*; and the present work on heavy artillery orientation was compiled by Major Clark as a textbook for use in the Coast Artillery School at Fort Monroe, Virginia, and in universities giving preliminary military training.

The representation of relief by the contour method, map scales and slope scales, the drawing of profiles, and the use of conventional signs are briefly but very effectively discussed. In a large measure the treatment is based on experience gained on the western front during the World War. Measurements are given in the metric system, and French maps and French methods receive special consideration. The use and care of surveying instruments and the construction and use of maps are explained in detail, this part of the work comprising nearly two-thirds of the total. The remaining chapters deal with problems falling particularly within the province of the artillery officer.

The text, which is based on articles contributed by instructors on the staff of the Coast Artillery School, is clearly written and well illustrated and will come measurably near achieving the purposes set forth at the close of the introduction, among which are the two following: "To give in a clear and concise form all the information necessary either for an orientation or a battery officer to solve the various problems of orientation that may arise in connection with a battery of heavy artillery executing map firing" and "to present the subject matter in a manner that will be intelligible to an officer who has had no training in civil engineering."

Douglas Johnson

Recent Books on Mapping and Surveying

J. K. Finch. **Topographic Maps and Sketch Mapping.** xi and 175 pp.; maps, diagrs., ills., bibliogr., index. John Wiley & Sons, Inc., New York, 1920. 9 x 6 inches.

W. L. Webb and J. C. L. Fish. **Technic of Surveying Instruments and Methods.** xvi and 319 pp.; diagrs., ill. John Wiley & Sons, Inc., New York, 1917. $2.00. 6¾ x 4 inches.

C. B. Benson. **Map Reading for Aviators, with a Chapter on Aerial Navigation.** 56 pp.; diagrs., ills. Edwin N. Appleton, Inc., New York, 1918. $1.00. 7 x 5 inches.

The keynote of "Topographic Maps and Sketch Mapping" is its directness and clarity of presentation. For this reason it should prove especially valuable for the introduction of the

subject to beginners. It assumes that the student has had no preliminary preparation and teaches him how to read a map from its purely mechanical standpoint. No attempt is made at map interpretation. The geological structure controlling the topographic features is ignored.

The second and third parts of the book are devoted to the preparing of simple sketch maps in the field and to landscape sketching. The methods are simple but effective, making available for the use of the layman methods which are used in a more elaborate way by the civil engineer himself. A useful appendix prepared by Mr. F. K. Morris contains a descriptive list of the principal topographic maps of the world.

"Technic of Surveying Instruments and Methods" presents a series of exercises and problems covering the whole field of surveying. It is "not intended to replace any general textbook on surveying, but to supplement the general directions of such a book by detailed directions for specific operations in field and office." It provides definite problems for drilling the student in the use of instruments and explains topographic and railroad surveys by describing the organization, equipment, and personnel of the parties and then in detail the various phases of the work. To the reviewer it seems that a little more instruction might have been given with regard to the plane table, in spite of the fact that reference is made to D. B. Wainwright's "Plane Table Manual" (Appendix 7, U. S. Coast and Geodetic Survey Rept. 1905). In common with most books and texts on surveying it fails to present the methods so nicely developed by the U. S. Geological Survey in this line.

"Map Reading for Aviators" is a pocket-sized booklet which aims to give the main elements of map reading. Map scales, conventional signs, contours and hachures, orientation are taken up briefly but clearly. The explanation of contours is aided by some especially good drawings. Several problems are given, together with the correct solutions, on the determination of speed of flight, correction for wind, and the use of the compass in the air.

A. K. Lobeck

Regional Bibliographies of Geology and Physical Geography

W. F. Ferrier and D. J. Ferrier. **Annotated Catalogue of and Guide to the Publications of the Geological Survey of Canada, 1845–1917.** 544 pp.; maps, index. Geological Survey of Canada, Dept. of Mines, Ottawa, 1920. 10 x 6½ inches.

Changes in system and form of publication since the inception of the Canadian Geological Survey render particularly valuable this analysis of its publications. Separate sections deal with the various types of reports, memoirs, bulletins, guidebooks, etc. A section entitled "Finding Lists" and accompanied by a series of index maps gives a regional bibliography, the arrangement being under provinces and territories. There is also a list according to authors, and an appendix gives a partial list of papers by members of the Survey staff published elsewhere but distributed by the Survey and in some instances still available.

J. Brüggen. **Bibliografía minera i jeolójica de Chile.** 142 pp.; indexes. Soc. Nacional de Minería, Santiago de Chile, 1919. 10 x 7 inches.

The titles included in this bibliography are classified by author under the sections (1) metalliferous deposits; (2) coal and petroleum; (3) salts, including nitrates, other fertilizers, sulphur, building stone; (4) mineralogy and petrography; (5) volcanism and mineral waters; (6) general geography; (7) geology; (8) paleontology. There is an index to each section. In view of Montessus de Ballore's exhaustive bibliography of Chilean earthquakes (*Rev. Chilena de Hist. y Jeogr.*, Vols. 18 and 19, 1916) references to this phase of volcanism are omitted from section 5. The section on geography is likewise short on account of the well-known bibliography "Ensayo de una bibliografía histórica i jeográfica de Chile," by N. Anrique and L. I. Silva. This, however, was published in 1901; and the present bibliography includes very few recent publications under the heading of geography.

Indice geográfico de las publicaciones del Instituto Geológico (1873–1919). *Bol. Inst. Geol. de España*, Vol. 40 (Vol. 20, 2nd Ser.), 1919, pp. 5–120. Madrid.

Indice por orden alfabético de autores de las publicaciones del Instituto Geológico (1873–1919). *Bol. Inst. Geol. de España,* Vol. 40 (Vol. 20, 2nd Ser.), 1919, pp. 5–64. Madrid.

The contents deal almost exclusively with Spain or Spanish possessions, including Cuba and the Philippines, held during the period covered by the bibliography.

T. H. D. La Touche, compiler. **A Bibliography of Indian Geology and Physical Geography, with an Annotated Index of Minerals of Economic Value.** Part I, xxviii and 571 pp.; Part II, ii and 490 pp. Published by order of the Government of India. Calcutta, 1917, 1918. 4 rupees each. 10 x 7 inches.

The author was Director of the Geological Survey of India from 1881 to 1910. The first volume of his present work takes the place of the bibliography compiled by R. D. Oldham and published in 1888. Arrangement in this volume is by authors. Only the minerals of economic value have been indexed as regards subject, and this index with valuable annotations constitutes Volume 2. The arrangement here is alphabetical with regional subdivisions. Numerical references in Volume 2 are to the bibliographical entries in Volume 1; hence it is necessary to use the earlier volume in conjunction with the later. Apparently the field covered includes regions contiguous to India: there are references to Afghanistan and the Malay Peninsula.

Two Governmental Reference Publications

G. P. Merrill, edit. **Contributions to a History of American State Geological and Natural History Surveys.** xviii and 549 pp.; ills. (portraits), index. *U. S. Natl. Museum Bull. 109,* Smithsonian Instn., Washington, D. C., 1920. 9½ x 6½ inches.

This is a volume of historical interest as well as a useful work of reference. It follows along the lines of a work projected by the United States Geological Survey in 1885 but subsequently abandoned. In general the several histories terminate with the date 1885. More recent activities of the surveys have been given in the *U. S. Geol. Survey Bull. 465* compiled under the direction of C. W. Hayes, 1911.

C. S. Sloane. **Fifth Report of the United States Geographic Board, 1890 to 1920.** 492 pp. Government Printing Office, Washington, D. C., 1921.

The volume embraces an account of the history and policy of the board, the report of the subcommittee on a system for transliterating Russian alphabetic characters in the spelling of place names, and all the decisions of the board from its establishment according to (1) general list, (2) Hawaiian names, (3) Philippine names.

CORRESPONDENCE

The Adaptability of the White Man to the Tropics in Australia

To the Editor of the *Geographical Review:*

In a recent number of the *Geographical Review* [August, 1920] there appeared a criticism by Mr. Ellsworth Huntington of a paper by us on the above subject. Mr. Huntington takes exception to a section of the paper dealing with mortality tables for Queensland, which section he describes as "peculiarly inadequate and misleading," and to prove this he makes certain categorical statements some of which are demonstrably incorrect.

These statements cannot be allowed to pass unchallenged, and we must ask permission for a small space in your *Review* in which to answer them.

The section in question was quoted almost word for word from a statement made to us by Mr. G. H. Knibbs, Official Statistician to the Australian Commonwealth, and he has kindly looked over this reply and supplied us with the additional information on the whole State of Queensland given below.

As stated in our paper, statistical data for Tropical Australia have not been published separately by the Commonwealth Authorities. Figures were therefore given for the whole State of Queensland, practically all of which lies north of the 29th parallel of south latitude, and of which 25 per cent of the population live north of the Tropic of Capricorn. This population further represents 95 per cent of the whole tropical population of Australia. It might be expected, therefore, that any unhealthiness of Tropical Australia would have left its impress on the vital statistics of Queensland. The figures furnish no evidence of lack of salubrity in those parts.

It was pointed out in the paper that, in the absence of complete data for Tropical Australia, it was not considered practicable to carry the test further.

Mr. Huntington criticizes these figures on the grounds that the "population of Queensland, especially in the tropical parts, differs from that of an ordinary country" in the following respects:

(1) It is composed of settlers who are more energetic than the average of their countrymen, and is largely migratory.

(2) Most of the people are men from 20 to 40 years of age, ages at which the death rate is low, whilst women, old people, and young children are scarce.

(3) Indoor work in factories is rare.

(4) In a scattered population where officials are scarce, a large number of deaths are not recorded even among highly civilized people.

The following facts show that most of these objections are without foundation.

(1) The recorded figures of arrival and departure by land and sea show nothing more than the normal movement due to business and pleasure shown for the rest of Australia.

(2) At the census of 1911 the proportion of men from 20 to 40 was 33.24 per cent of the male population, that for the whole of Australia being 32.76 per cent; this represents 18.08 per cent of the general population of Queensland, the figure for the Commonwealth being 17.01.

Children less than ten years of age formed 22.73 per cent of the population of Queensland, 22.07 for the whole of Australia. Persons over sixty years of age formed 5.6 per cent of the population in Queensland, 6.41 per cent for the Commonwealth.

The masculinity of the state was only 52.1, 51.9 being the figure for the Commonwealth.

(3) In Queensland, as in other states, the great majority of the population lives in the towns, and indoor work is carried on in shops, offices, and warehouses, etc., entirely by white men. The state has a large number of frozen meat and canning works, and sugar mills, many of which are situated in the tropical area.

(4) The police officials who furnish returns in the outlying districts do their work very efficiently, and it is not possible that large numbers of deaths escape record. Probably only a very small number indeed escape registration.

The above figures represent data for the whole state of Queensland which is seen to be an average state of the Australian Commonwealth, and Mr. Huntington's objections cannot apply to the figures as given in our paper.

Since the paper appeared further statistical data have been taken out for Tropical Queensland by one of us (A. B.), and the results of this investigation are now in the press. A few points may be noted here.

In the coastal areas of Tropical Queensland where the bulk of the population resides, the proportion of males to females (census 1911) is 1.177 to 1; in the inland districts, chiefly mining and pastoral, the proportion is 1.672 to 1.

The average death rates are practically the same in the northern districts of Queensland as in the central and southern districts.

The birth rates are approximately the same in all the coastal districts of Queensland, northern, central, and southern; whilst the infantile mortality rate for the northern districts is lower than those for the central and southern districts.

This enquiry has shown that North Queensland, as far as vital statistics are concerned, does not differ essentially from the rest of the State and compares favorably with Victoria and Tasmania, the two most southern states of Australia.

Unfortunately data were not obtainable for taking out death rates for different ages.

It would be interesting to learn what was the authority upon which Mr. Huntington based his statements.

Yours faithfully,

A. Breinl
W. J. Young

May 19, 1921.

To the Editor of the *Geographical Review:*

Please accept my thanks for your courtesy in sending me a copy of the letter of Messrs. Breinl and Young. I appreciate their earnestness and sincerity in trying to find out the exact truth regarding the adaptability of the white man to the tropics. Their difficulty is the same as that of everyone who studies the health of the tropics, namely, the absence of reliable statistics. Their own data illustrate this. For example, in 1911 the masculinity of Queensland as a whole, that is the number of males per 100 inhabitants, was only 52.1, or 109 males for 100 females; but in the fairly well populated coastal areas of the tropical part of Queensland the proportion of males to females was 118 to 100, while in the inland districts—chiefly mining and pastoral—the proportion was 167 to 100. In other words, in the tropical parts of Queensland the proportion of men is from 8 to 60 per cent greater than in the nontropical parts. But even in the nontropical parts the percentage of men from 20 to 40 years of age (18.08 as given by Breinl and Young) is 10.4 per cent greater than in the "standard" population of the United States in 1900, and 17.9 per cent greater than in England and Wales in 1901.

Among this large proportion of men in the prime of life the percentage who are shut up in the stuffy, dusty air of factories in big cities is certainly far smaller than in England or the northeastern United States; but as to this no data are forthcoming. Similarly, men who are sickly rarely go to tropical Australia. They fear the climate; and also they usually do not have the necessary energy or the capital; but we have no statistics on this point. Once more, almost all the adults in tropical Australia were not only born but grew to maturity in climates of a different type from that where they now live. Hence their health depends on the earlier environment as much, or more, than on that of their present homes. Moreover, unless the people in tropical Australia have less wisdom than most British colonists in hot countries, many go "South" or "Home" when their health begins to suffer, or while the children are young. Thus many deaths are deferred and perhaps credited to other places. In the absence of data on all these points, a mere comparison of crude death rates furnishes little evidence as to the effect of tropical Queensland upon permanent white settlement. I may have been wrong in thinking that many deaths fail to be recorded, for British police are efficient; but the statistics thus gathered are scarcely comparable to those of a settled, permanent, native-born population in a manufacturing country.

It seems to me that Messrs. Breinl and Young have attacked only half of their problem. On the basis of statistics whose inadequacy they are the first to recognize they conclude that there is no "evidence of lack of salubrity in tropical Australia." They have entirely omitted any consideration of the extent to which the statistics are influenced by the conditions mentioned above and by many others. What is needed is accurate statistics tabulated by age, by sex, by race, by place of nativity and childhood, and by climate. A beginning might be made by analyzing the deaths of native-born Queenslanders in the larger towns for a

period of 10 years before the war. This would involve a study of the original records, but it could be done. It would pay because it would give data that could scarcely be questioned.

My own method also leaves half the problem unsolved. I based my statements not on definite information as to Queensland, but on what is known of tropical lands in general, and also on our knowledge of the effect of specific climatic conditions at various seasons elsewhere. For example, the records of insurance companies show that in tropical countries the death rate among policy holders is extremely high. Yet the people who are insured are on the whole the most intelligent and careful of the people who go to the tropics. Again we know that when climatic conditions like those of tropical Australia prevail for a season in any part of our own country the death rate is high.

The point which this discussion emphasizes is the necessity for very accurate and almost meticulously minute statistics of mortality and disease for small geographical divisions and for long periods. The analysis of such statistics is a formidable task, but it is the only way to determine just what effects are produced by different climates and how those effects may be overcome. It is a mistake to attempt to "prove" anything about a climate. What we want is the facts. Knowing these, I believe that we can so regulate our lives that even in the tropics the white man can live and prosper. If we gloss over the unpleasant facts we thereby condemn to weakness and early death many whom the progress of science might otherwise make happy and long-lived.

Yours sincerely,

Ellsworth Huntington

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MODES OF LIFE IN THE MOROCCAN COUNTRYSIDE

INTERPRETATIONS OF AERIAL PHOTOGRAPHS

By JULES BLACHE

During the course of a year's sojourn in Morocco the writer had an opportunity for aerial reconnaissance of regions difficultly accessible by land, in some instances beyond the limits of French penetration, and unknown to Europeans. The character of the land forms seen therein has been described elsewhere.[1] The following pages recount the diverse modes of life in Moroccan mountains and plains and the human aspects of the countryside as seen from the air.

THE EXTREME MODES OF LIFE: NOMAD AND SEDENTARY

Before going into detail let us for a moment examine the two extreme modes of life, nomad and sedentary. That they are opposed to each other is obvious from the first glance. On the one hand is the nomad wandering over his pasture grounds, carrying with him in his regular migrations all that he possesses—his family, his flocks of sheep, his goats and camels, and his tent. On the other hand is the sedentary cultivator attached to his fields, his trees, and his house. These two aspects of human economy are not peculiar to Morocco of course; they are found intimately mixed on the uninterrupted belt of steppes and desert that stretches from Morocco to Mongolia.

Figures 2 and 3, on the one hand, and Figure 4, on the other, show in concrete form the opposition of these two modes of life. Here we have (Fig. 2) the black tents, 6 or 8 meters long, made of strips of fabric, wool or goat hair mixed with vegetable fiber, supported on poles. They appear against the rocky surface as little rectangles grouped in circles, each of which

[1] Jules Blache: Quelques aspects des montagnes marocaines, *Rev. de Géogr. Alpine*, Vol. 8, 1920, No. 2, pp. 225–258. Grenoble. Reviewed in the *Geogr. Rev.*, Vol. 11, 1921, pp. 455–456. See also *Idem:* De Meknès aux sources de la Moulouya: Essai d'exploration aérienne au Maroc, *Ann. de Géogr.*, Vol. 28, 1919, pp. 293–314.

constitutes a *duar*. The dwelling of the chief is the largest, those of the poorer families are correspondingly small. In the interior of the *duar* is an enclosure where the animals are picketed at night. It appears darker in the photograph because the soil, fertilized with animal manure, is tinged with verdure.

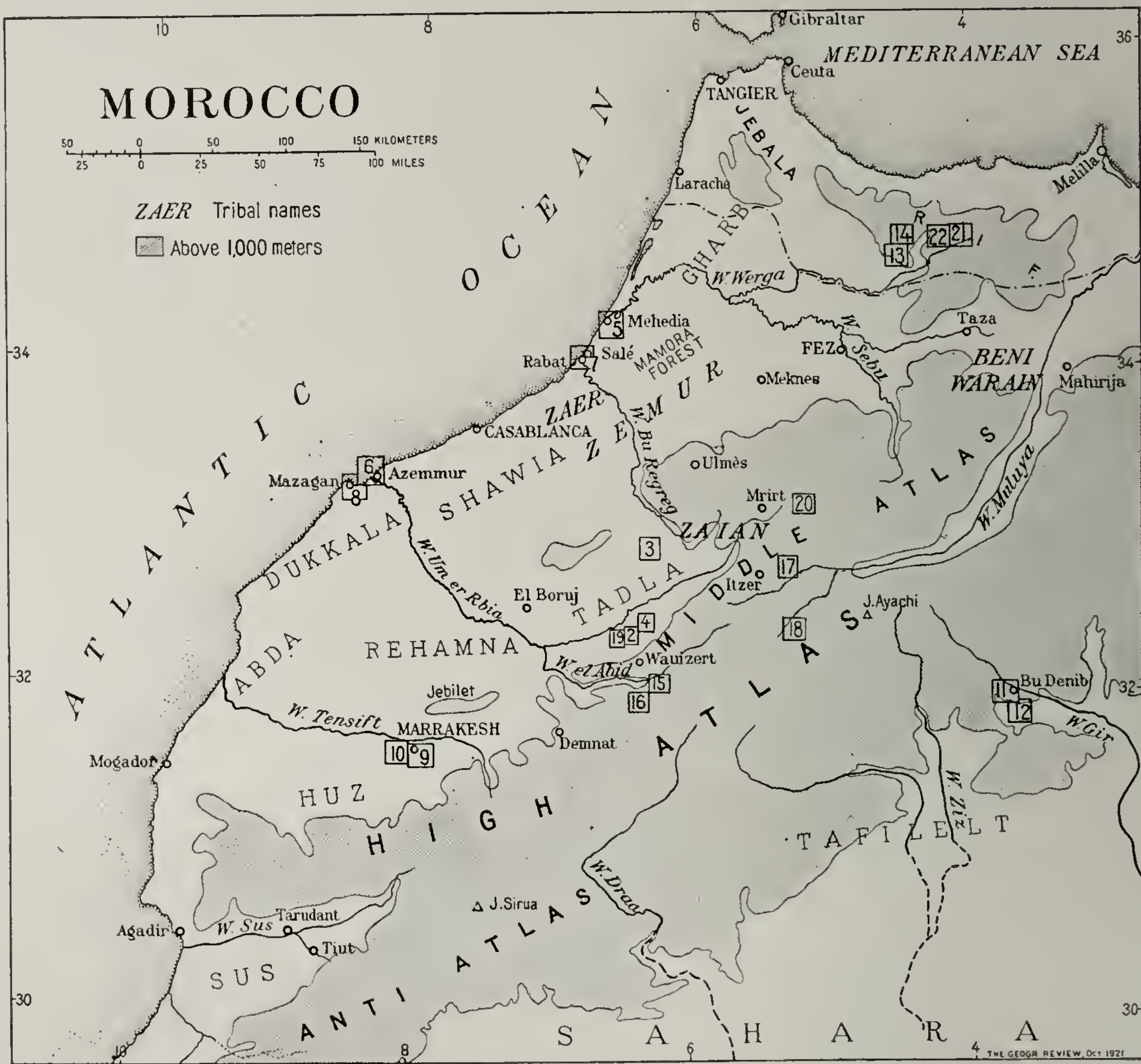

FIG. 1—Sketch map of Morocco. The numbered squares indicate the approximate location of the landscapes shown in the following photographs, Figures 2–22.

Towards the bottom of the photograph another form of habitation is shown in the series of little cones about other enclosures. They have a tendency towards circular grouping like that of the tents but less regularly. These are the *nuala*, small cylindrical huts of branches or pressed earth surmounted by a conical roof most often of straw. A group below the large *duar* of the center of the photograph shows the association of a tent and four *nuala*. This association of the fixed shelter and the mobile shelter is somewhat surprising. The people with whom we are dealing are pastoral; the soil is not cultivated at all, it does not in fact appear to be cultivable. The slope seen in the upper left-hand corner of the picture is lined with innu-

merable roughly parallel sheep tracks. The occurrence of the *nuala* merely means that the tribe has remained for some length of time on the same pasture ground. The poorest families occupy these crude huts, less comfortable than the tent but quickly constructed and more economical.

Neither the *nuala* nor the tent, however, is exclusively the dwelling of the nomad. Many cultivators, yesterday nomads today in possession of agricultural lands, have retained the shelters of their ancestors. Tent, *nuala*,

FIG. 2—*Duars* (tents) and *nualas* (earth huts) on the southern margin of the Tadla region. Vertical view. Scale approximately 1:5,000.

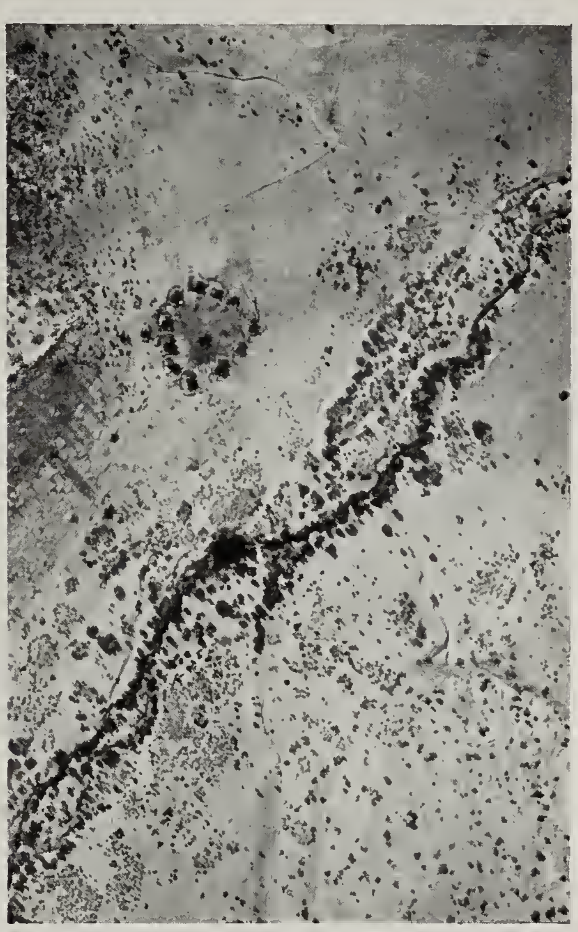

FIG. 3—*Duar* in the Zaian country. Gallery forest along a little wadi. Vertical view. Scale approximately 1:6,000.

and *gurbi*—the last with a more elongated keel-shaped straw roof—are found in Morocco among the cornfields as on the pasture grounds. They are, as we shall see, the homes of cultivators less firmly attached to the soil, those who possess neither orchards nor irrigation facilities; in other words, seminomadic cultivators who still retain important pastoral interests. Thus the sight of the tent does not necessarily signify nomadism proper; it is suited to other modes of life.

On the other hand the house, *dar*, is the sign of sedentary occupation; along with it go trees, cultivations, irrigation canals, silos. Figure 4 shows the form of the house, a rectangular structure built round a central court into which open the rooms, while the bare wall of the exterior is broken only by a single door. The walls are of adobe, rarely of stone even when it might be quarried near by. The roof, supported by horizontal beams, is covered

with thatch or branches plastered over with earth, and there are flat terraces where one may walk. The roof is difficult to construct and must be kept in careful repair. An abandoned house with collapsed roof is seen in the upper left-hand corner of Figure 4.

The elementary house type aligned on a single front is rare in Morocco. Yet it is seen in certain mountain districts, particularly in the Rif. Frequently these houses, while remaining detached, tend towards a horseshoe grouping or a square (Figs. 13, 14, and 22) approximating the plan of the *dar* in Figure 4. In like manner between the rectangular *dar* and the *kasba*—the little fortified town, walled with bastions and battlements (Figs. 21 and 22)—one finds insensible transitions, and diversity of types may even be seen in the same agglomeration.

The upper right-hand corner of Figure 4 shows us a rocky plateau, in large part sterile, whose border of houses defines a line of springs from whence water is distributed to the gardens and orchards (center of figure) and to the fields (lower part of figure). The distributing canals are distinguished in the photograph by their roadlike appearance. Lines of bushes crown the channel banks in the areas given over to the orchards wherein olives, peaches, plums, and oranges flourish. In their shade are the gardens. Fields cover all the lower part of Figure 4, being separated from the zone of orchards by a great transverse channel. Irrigation of the fields here shown is accomplished from two main distributing channels divided into branches which in turn divide into shallow ditches, almost parallel and only 2 or 3 meters apart. To ensure an equal distribution of water these are traced afresh after the fields have been tilled. The larger channels bordered by continuous banks are more permanent. In the upper right-hand corner the ground appears riddled with deep holes, and a similar appearance is presented between the most elevated part of the escarpment and a group of houses at its foot. These are the silos, pits once roofed over and kept in good order for the concealment of grain either against the investigations of the tax collectors, agents of Sultan or kaid, or for protection against the designs of a too enterprising neighbor.

Distribution of Nomad and Sedentary Types

The distribution of these two types is our next concern: where are the sedentary peoples, where the nomads? Their distribution in Algeria was formerly explained on historical and racial grounds. The sedentary peoples were the ancient occupants of the country; the nomads were the Arabs, descendants of tribes who invaded the country as "a swarm of locusts" at the beginning of the ninth century. The theory is no longer held. There have always been nomads in Barbary. Again, by the side of sedentary Berbers (Kabyles) exist nomads of the same race (Tuaregs) and sedentary Arabs.[2] Nomadism is not the monopoly of a race, a stage in the history of civilization, but a fruit of climatic conditions.

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[2] Augustin Bernard: Le Maroc, Paris, 1913, p. 142.

It is only in the desert that nomad and sedentary peoples live side by side in opposition and as strangers to each other—the man of the plow and the man of the tent, the one in the oasis and the other on his meager pastures.

FIG. 4—Houses (*dars*), orchards, irrigated fields, and silos on the southern margin of the Ṭadla region. Vertical view. Scale approximately 1:3,500.

In the Moroccan steppes the two types may be combined in the same tribe, even in the same individual; in fact there is hardly anything but the mixed type.[3] Water, under a climate which varies from that of the Mediterranean

[3] *Ibid.*, pp. 145–146.

type to that of the dry steppe, is everywhere sufficiently abundant for some cultivation. There is no devotion to purely pastoral pursuits by a people to whom "dishonor enters with the plow." The Moroccan nomads all cultivate the land a little at some season of the year.

At the same time there are few agriculturists who are strangers to some aspects of pastoral life. How could it be otherwise in a country sparsely populated, where the cultivated areas occupy only a limited part of the surface? Extensive stock-raising represents the most natural, the most general, and the most historic method of utilizing empty spaces in the neighborhood of cultivated land, whether sterility be the result of climate, of soil, or of man. The sedentary peoples have their flocks and their shepherds. Most often the flocks return at night to the interior courtyard of *kasba* or *dar*, which is designed not only as a fortress but also as a corral. Not uncommonly the flocks are truly nomadic, pastured far from the cultivated fields. Then it is prudent to accompany them with a considerable force, for this is a country where "garder les troupeaux" is not an idle phrase: a part of the tribe, even the entire tribe may accompany the flocks. Thus we have a semisedentary type which grades into the seminomadic.

We shall now proceed to an examination of the different modes of life in the great natural regions of Morocco, observing them as they are manifested in the landscape by the form and disposition of the dwelling place, the character of the agriculture, and the general aspect of the country. Between Sahara and Mediterranean there are, as we have already said, delicately graded transitions.

Rural Life in the Moroccan Meseta

The plains and plateaus rising gently from the Atlantic and enclosed north and south by two mountain systems, the Rif and the Atlas, form the richest and most populated part of Morocco. It has been called the Moroccan Meseta by analogy with the central Spanish plateau, the Iberian Meseta.[4] It is an ancient peneplain for the most part covered with comparatively recent, horizontally disposed sediments; but the ancient surface is exposed on a section of the coast, in the plateau of Ulmes and in the mountainous relief of the Jebilet, to the north of Marrakesh. On the border of the Atlas, Quaternary alluvium defines the limits of a recently emptied lake: this is the Tadla. To the south of the Rif a strait connecting the Atlantic and the Mediterranean opened at a recent epoch (Miocene): the couloir of Taza and the alluvial plains of the Lower Sebu recall the existence of this predecessor of the Strait of Gibraltar.

The surface of the Meseta is comparatively well watered by winter rains of the Mediterranean type. The yearly rainfall amounts to 400–600 millimeters distributed over 50–80 days, and it is supplemented by heavy dews. In consequence we have a country where irrigation is not indispensable for

[4] Louis Gentil: Le Maroc physique, Paris, 1912, p. 4.

Fig. 5

Fig. 6

Fig. 5—Mouth of the Sebu. In succession from the ocean border are cordon of wooded dunes, lagoons, agricultural plain, edge of the Mamora forest. Altitude of airplane 1,500 meters.

Fig. 6—The monotonous stretches of the agricultural plains of the littoral broken only by the white patch representing the city of Azemmur situated on the left bank of the Um er Rbia, which is here seen emptying into the ocean on the right. At the other extremity of the bay Mazagan is faintly visible as a light-colored band. Altitude of airplane 1,200 meters.

Fig. 7—Mouth of the Bu Regreg which separates the towns of Salé (to the right) and Rabat (to the left). In the center is the famous tower of Hassan (see photograph in the *Geographical Review*, Vol. 8, 1919, p. 28). Altitude of airplane 150 meters.

agriculture, cereals in particular. The Atlantic border, the best-watered section, is furthermore favored in respect of the soil; the *tirs*, or black earth, and the *hamri*, or red earth—whose origin is still a matter of debate—are much more extensively distributed than the sandy *remel* or the stony *harrucha*. The plains of Abda, the Dukkala, the Shawia, the Gharb are the heart of agricultural Morocco. It is only in the interior plains to the south of Wadi Um er Rbia and to the north on the plateaus of El Boruj and Ulmes that, in default of regular rains and deep soils, cultivation, outside of some rare irrigated spots, becomes really meager.

What manner of life is developed on the most fertile of these plains, areas where neither soil nor climate could be more propitious for agriculture? Traveling over the vast open surfaces one sees uncleared stretches clustered with *dum*, or dwarf palm, and realizes with surprise that cultivation everywhere bears a nomadic aspect. The cultivator dwells in the *gurbi* or more commonly in the tent. Houses, domiciles of large proprietors, are rare and always isolated: there are no villages. Flocks of sheep, goats, cattle are numerous, and the periodic migration known as transhumance is general. The inhabitant of the rare oases of cultivation in Ulmes and El Boruj, infertile steppes mainly occupied by the gazelle and nomad flocks of sheep, is distinguished from the dweller of the fertile Atlantic plains, Dukkala or Shawia, only by the unequal proportion of agricultural and pastoral resources. All cultivate the soil and practice transhumance more or less, and all dwell under the nomad tent in the same wide-horizoned steppe land.

Everywhere great stretches of good land are sacrificed to the pastoral life. Even the richest regions, Abda and Dukkala, where two-thirds of the land [5] has been cleared and where "it is sufficient to throw grain in the air to have it germinate," have been occupied until recently by mobile tribes of whom a remnant survives today on the now limited pastures.[6] The Shawia and the Gharb have in particular remained the domain of instable populations. In the Shawia the fields of corn, maize, and beans are interrupted by great stretches of ground covered with *dum* and sprinkled with marshes (*daias*) which serve as watering places for the stock. Each *duar* has its sheep, goats, and cattle. The richest lands of the Gharb, notably along the lower Sebu, were chiefly devoted to stock before the recent installation there of some French farms. The back country of Rabat, where the *tirs* is rare and the old rock outcrops more extensively, is the domain of the Zaers and Zemurs, seminomads, whose cattle and sheep migrate the greater part of the year in a circle defined by the relative humidity of the soil. It is practically only along the wadis that one finds their restricted fields of barley near the irrigated gardens.[7] Farther north seminomads are still disputing the great cork-oak forest of Mamora; before French occupation the Zemurs, the latest

[5] Conférences franco-marocaines, I: L'œuvre du protectorat, Paris, 1916, p.197.

[6] J. Goulven: La région des Doukkala, *Ann. de Géogr.*, Vol. 29, 1920, pp. 127–138; reference on p. 134.

[7] Conférences franco-marocaines, p. 193.

conquerors, found there summer pastures and haunts whence they could levy ransom on the neighborhood. The plain of Meknes, dry but still cultivable at all times without irrigation, is very irregularly exploited.[8]

What is the cause of this prevading pastoral tinge of life on the Meseta? It is perhaps possible to disentangle the historic, social, and geographic causes. In the first instance the pursuit of agriculture has always been more or less precarious on the great plains bordering the Atlantic, open to invasion, subjected without possible succor to the various dominations that have been set up in Morocco. From the south has come the constant pressure of the nomads in quest of better pasture, that is to say a more humid climate. Victorious over the sedentary peoples because more mobile they have become semisedentary themselves, cultivating a part of the most fertile soil of the conquered territory but never completely renouncing their pastoral interests. To do so would be to lose entirely their former advantage; in his turn conquered and expelled from the land the seminomad, while his stock remains to him, has not lost all. Furthermore, when the nomad installs himself on good land he is at first likely to see in it good pasturage rather than tillage. The man of the tent not only leads a freer, less laborious life than his sedentary neighbor, he is generally richer. Besides his stock he has a saddle horse and firearms. In the region of Mahirija of eastern Morocco the nomads possess four times as many cattle per head as the sedentary people, who have been reduced by poverty to an inferior condition.[9] Everything tends to suggest that in the Moroccan Meseta it is overpopulation with its consequent impoverishment of the newcomers into the territory, that has forced them to the plow. Possibly the passage from nomadism to agriculture—quite early in western Europe, more recent and more complete in many of the Mediterranean countries—is everywhere related to this cause.

We must add emphatically that here in this part of Morocco the agriculturist can revert to nomadism without difficulty; there is nothing to attach him permanently to a fixed piece of ground. Under natural conditions trees are rare; they are limited to certain figs, whose roots penetrate sufficiently deep to resist the summer drought, and to some thorny plants (cactus, aloes), which serve to make enclosures for the cattle. Irrigation is impracticable. The only permanent sources of water are the wells, often sunk to great depths and everywhere necessary for the supply of drinking water. The appearance of irrigation canals and orchards means that there the life of the agriculturist takes on a more settled aspect. A similar relationship has been noted in Algeria between the farmer who cultivates cereal crops only and the fruit grower; the former dwells in a *gurbi*, the latter in a house.[10]

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[8] *Ibid.*, p. 191.

[9] *Bull. Soc. de Géogr. du Maroc*, Vol. 2, 1920, pp. 271–275.

[10] Augustin Bernard and Edmond Doutté: L'habitation rurale des indigènes de l'Algérie, *Ann. de Géogr.*, Vol. 26, 1917, pp. 219–228; reference on p. 222.

The Towns of the Meseta

However primitive the exploitation of these Atlantic plains, they yet constitute the heart of Morocco, the basis of the Sherifian Empire—the *Bled Makhzen*—the only territory where the authority of the Sultans ever made itself felt in a permanent manner. There the rulers built their capitals, there are the towns of Morocco. They are few in number; but the gardens and orchards which surround them, the high walls, the close-crowded white houses contrast so startlingly with the monotonous steppe and its obscure sprinkling of tents and *gurbis* and rare *kasbas* that the Moroccan towns give

Fig. 8—The Portuguese fortress of Mazagan (sixteenth century). Altitude of airplane 250 meters.

the impression of an entirely different world, a life completely distinct from that of the fields. The transition which in Europe leads from the village to the country town and from the town to the city is here absent. The towns are not prosperous agricultural centers, market places that have grown slowly to their present prominence, but the creation of their Sultan builders. In Morocco urban settlement has, in general, had an entirely different history from rural settlement.

Fez, the capital, was founded in 808 by Mulai Idris, son of an Arab of the Hejaz, patron saint of Moslem Morocco. Peopled by Moslems of Europe and Tunis who long disputed its possession, the old town (Fez el Bali) is still divided into two centers separated by walls and united only by a single bridge across the Wadi Fez. On the one side is Fez el Karauyine, of the eastern Moors; on the other Fez el Andalus, of the Spanish Moors. Some centuries later Fez el Jedid, the new town, was built outside and peopled

Fig. 9—Orchards at Marrakesh round a reservoir supplied by *foggaras*, the funnel-shaped openings of which are seen in the foreground. In the foreground are also irrigated fields. Altitude of airplane 250 meters.

by soldiers, negroes, and day laborers. The whole city counts some 100,000 natives within its still imposing walls in the midst of olive and orange groves which shelter palatial edifices. The middle ages still live in its narrow streets running between moldering walls, in the corporations and shops, in the markets (*suks*), in the Moslem colleges (*medersas*).

Meknes (Mequinez), the old capital of Mulai Ismail (seventeenth century), the ruins of whose palace cover a whole section, is known as the town of 40 kilometers of ramparts. Ruins of ancient fortifications to this extent may be traced at some distance from the present walls. The town is also known for its tree-planted streets and its encircling olive gardens.

Rabat, Ribat el Fath, the camp of victory, built in the twelfth century by Yacub el Mansur on the banks of the Bu Regreg, is distinguished as a seat of the arts and letters. It stands face to face with Salé, the white, a nest of pirates who furnished the markets with Christian slaves up to the nineteenth century (Fig. 7).

Like Salé on the Bu Regreg, Azemmur on the lower course of the Um er Rbia and Mehedia on the lower course of the Sebu are river ports formerly accessible to maritime navigation when the requirements were less exacting than they are today. They were the more esteemed by mariners because the regular coast offers no other shelter against the west winds than such open roadsteads as those of Casablanca and Mazagan (Fig. 8). These last towns—with a population of disparate elements, largely commercial, without aristocracy or culture—are alien to the traditional religious character of the cities of Fez, Meknes, Rabat, and Salé. Casablanca (Dar el Beida, the ancient Anfa) was the port of Shawia, before it was chosen as the base of European penetration. Mazagan is the port of Dukkala. It was founded in the sixteenth century by the Portuguese and held by them, their last stronghold in the Dukkala country, until the middle of the eighteenth century. The massive walls still remain. The modern revival of Mazagan has been rapid. The prosperous port looks over towards its former rival Azemmur, where commerce flourishing in the Portuguese days has been shut out by the bar across the mouth of the Um er Rbia.

The South of Morocco

Dryness and heat increase as one travels southward. Beyond the Um er Rbia, save for the Atlantic fringe of the Dukkala and Abda, irrigation becomes necessary if harvests are to be plentiful and sure. Yet in all southern Morocco farming without irrigation persists; it is practiced, within restricted limits to be sure, up to the Sus. But the steppe, dotted with jujube trees, becomes more desert; cultivation progressively diminishes, pastoral pursuits taking its place over vast stretches. At the same time irrigation works assume greater importance. The cultivation thus made possible is accompanied with fruit growing—dates, oranges, olives, apricots. Thus shapes itself the contrast between sterile steppe and nascent oasis. A new landscape appears with features more sharply defined than north of the Um er Rbia.

The Meseta is the domain of a population comparatively homogeneous over large areas: agriculturists possessing live stock and pasture grounds, living in the tent or *gurbi*. Here distinctions begin to appear. The farmer who, thanks to his irrigation canals (*seguias*), can water his fields regularly is definitely sedentary. He keeps his cattle and may even carry on extensive transhumance; but his precious orchards, his patient irrigation works, root him to the soil. He builds houses with flat terraced roofs and abandons the shepherd's tent. He still grows cereals, but crops are precarious; he counts on precipitation from storms and water from the wells to supply his little property.

Such are the fundamental features of the country to the south of the Um er Rbia. Let us look at the regional varieties. The Rehamna, to the north of Jebilet, and the Huz, or plain of Marrakesh, to the south are well differentiated from the great agricultural lands of the north. On the horizontal plains covered with alluvium from which emerge the black masses of the Jebilet, mountains drowned in detritus, good land is not uncommon, especially in Bahira, the western part of Rehamna. But water is deficient, and cultivation is sparsely distributed through the scant pasture sprinkled with jujube trees. Irrigation is difficult; the dwindling Tensift is already brackish and unsuitable for watering purposes in the summer. The population is correspondingly inclined towards nomadism. They practice a little agriculture; but the wheat must be sown thinly, and the maize is fed to the cattle unless some providential storm swells the grain. Wells serve for supply of the little properties; water is drawn by hand in sewn skins. In the Jebilet dikes and canals are constructed to carry to the fields the storm water falling on the mountain slopes. But when rain falls it is more particularly the pastures that benefit. Flocks and herds then gather to Bahira from all the surrounding country unless their summer migration has carried them to the Jebilet to seek, for lack of better fodder, the tough but never-failing *Stipa tortilis*, or towards Abda and Dukkala where dews support a more luxuriant herbage.[11]

Above the alluvial levels of the plain of Huz rises a large town, Marrakesh, the red city, an oasis supported by the Atlas waters collected in a multiplicity of underground conduits. These *foggaras* (Figs. 9 and 10) are the hidden bond by which an immense palm garden is related to the distant mountains. The numbers of blacks as well as Berbers, the adobe houses, the silent orchards of orange, citron, and olive trees enclosed in rigidly geometrical walls (Fig. 9) give the capital of the south an air suggesting the approach to Saharan conditions.

To the south of the Atlas is the Sus, the most southerly plain of Morocco, enclosed to the south by that comparatively recent offshoot of the Atlas, the Anti-Atlas. It also presents a generally uniform alluvial surface broken, however, by certain limestone undulations. Cultivation without irrigation

[11] *Bull. Soc. de Géogr. du Maroc*, No. 10, pp. 65–87, *passim*.

persists for certain cereals. Gardens under the fig trees are supplied at the cost of considerable pains with water from the wells. The dry lands are devoted, as elsewhere, to extensive pasturing of goats and sheep; but they lose the steppe aspect that prevails in the north. One tree in particular, the argan, associated with brushwood and the cypress-like thuja, prospers on the driest calcareous soils, where it forms a veritable forest cover. The oil furnished by its nuts is an essential food resource for the Berber Chleuh who people southern Morocco.

FIG. 10—Part of the city of Marrakesh showing the urban character of the dwellings, the walls, *foggaras* (indicated by the line of funnel-shaped openings), and orchards. Vertical view. Scale 1:6,200.

The axis of the plain occupied by the Wadi Sus is a ribbon oasis, a little Egypt, which dies out downstream. Upstream the oasis ramifies into branches extending far up into the mountains. The Atlas border is the scene of a particularly active life. The stone or adobe houses are most often grouped round a sanctuary or near the solidly built residence of a kaid. The oases are planted with olives, the oil from which is sold at Marrakesh.

The left bank, less well watered by the streams from the Anti-Atlas than is the right bank from the Atlas, has only one oasis, though this is a fine one, Tiut. Tarudant, capital of the Sus, is a fortress.

From the Sus a temporary emigration is directed towards the Gharb and the province of Oran; and there is a definite stream of permanent emigration to the Moroccan towns, where the emigrants find occupation as vendors of oil and dates or as traders in copper wares.[12]

On the Saharan slopes of the Atlas, that is to say in the oases of Draa and

[12] Conférences franco-marocaines, pp. 361–384.

Tafilelt, the progression that we have followed towards the life of the desert reaches its consummation. Nomad and sedentary are perfectly specialized.[13] The former, who has neither spring nor *seguia*, cannot undertake any form of cultivation, however precarious, even in winter. The latter, confined to the oases, dwells in the *kasbas* with their square buildings of urban character (see Figs. 11 and 12).

Climatic and Hydrographic Functions of the Moroccan Mountains

Human establishment in the Moroccan mountains is affected by certain permanent elements. The mountain country is richer than the plains in water, in summer pasturage, and in shelter.

With more abundant rains than the neighboring plains, with a snow cover which in parts lasts for several months of the year, and with a cooler summer the mountain region offers greater facility for non-irrigated cultivations. Furthermore, the watercourses are more numerous, and their regimen more stable, than those of the plains. In general these two advantages are not put to simultaneous profit.

The Rif and the Jebala, regions of highly developed relief, much dissected as the result of prolonged erosion of a complex structure, recall certain parts of the Alps. Precipitation is heavy in the interior of the massif. These are *tell* countries. Human life there presents a highly individualized aspect, whose replica is found in Algeria in the so-called Tell.[14] By preference the villages are aligned along crest summits exactly as they are in Kabylia. The house, which is quite small, is often of the elementary type with a sloping roof. The bottoms of the valleys are deserted. Olive and the fig are the principal fruit trees, with the walnut in the high valleys. The olive groves of Ferhun, north of Meknes, count some 200,000 trees. The orchards of the northern Gharb are particularly flourishing. Terrace cultivation (Fig. 14), common on the steeply inclined slopes, completes this aspect of a Mediterranean country and suggests nothing of the mobile population of the Meseta.

The Atlas is very different from the Rif from every point of view, physical and human. The mountain border is here well defined. Tabular surfaces, calcareous for the most part and almost horizontal, rise by steps to surfaces developed upon simple folds; such is the Middle Atlas. It has been described as a Jura, but it is a Jura greatly simplified as to structure and less developed as to relief (Fig. 20). Behind it the high folds of the Great Atlas present regular unbroken crests to the north, a little more cut up to the south, and are everywhere greatly elevated sometimes passing 4,000 meters in altitude. The whole exhibits certain common characteristics: regularity of structural lines and relief in a little advanced stage of evolution, wherein figure very

[13] E. F. Gautier: Nomad and Sedentary Folks of Northern Africa: *Geogr. Rev.*, Vol. 11, 1921, pp. 3-15.

[14] Marcel Larnaude: Excursion interuniversitaire en Algérie, *Ann. de Géogr.*, Vol. 30, 1921, pp. 161-194; reference on pp. 189-190.

FIG. 11

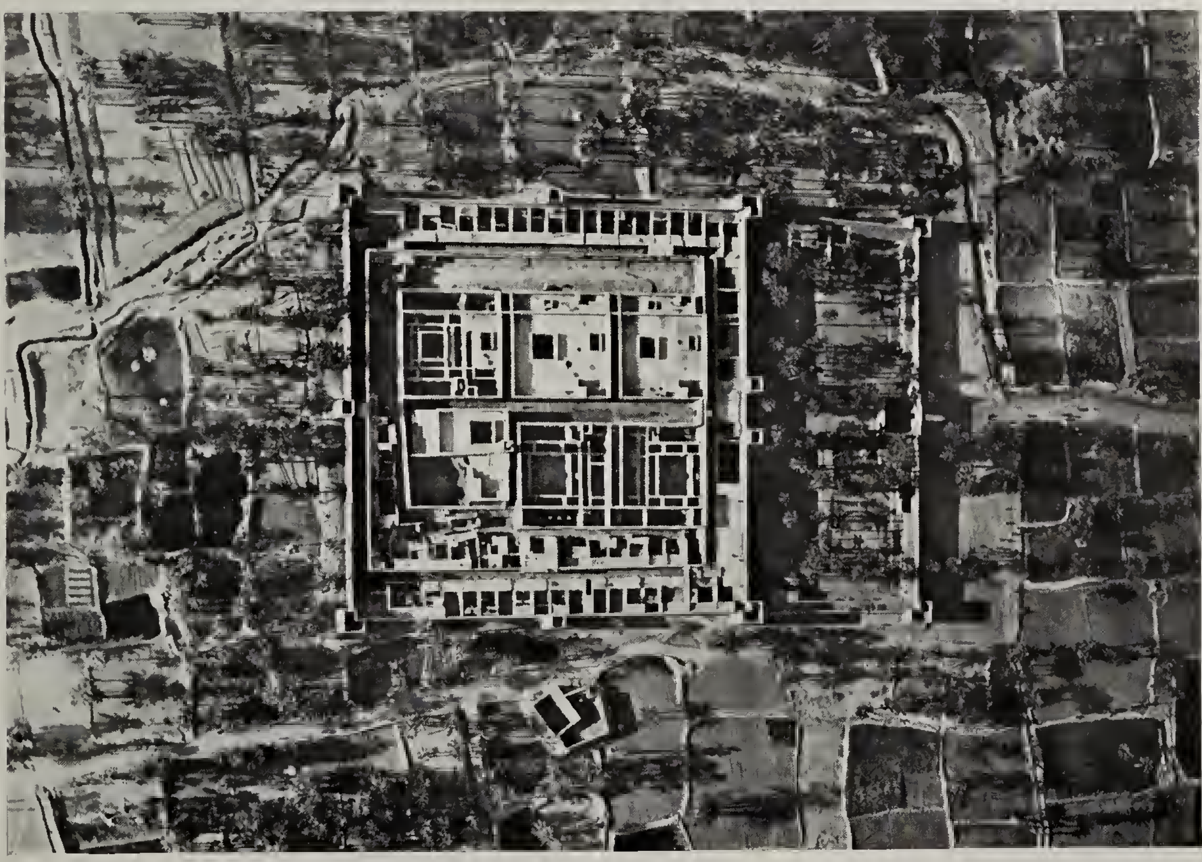

FIG. 12

FIG. 11—*Kasbas* (fortified settlements) in palm groves, vicinity of Bu Denib, Saharan slope of the High Atlas.
FIG. 12—Vertical view showing the detail of a *kasba* seen on the right of Figure 11.

high interior valleys, plateaus, and crests little dissected except by certain impassable gorges that open into the wadis of the low country. These mountains shelter varied types of life. The slopes having the best exposure are well favored in comparison with the interior valleys, which are often very dry, and with the neighboring Atlantic plains. Figure 15 shows a country of almost *tell* character, with dispersed cultivation and storied houses. Again, we shall find some of the distinctive characteristics with which we are familiar in the Rif—villages perched on crest lines overlooking

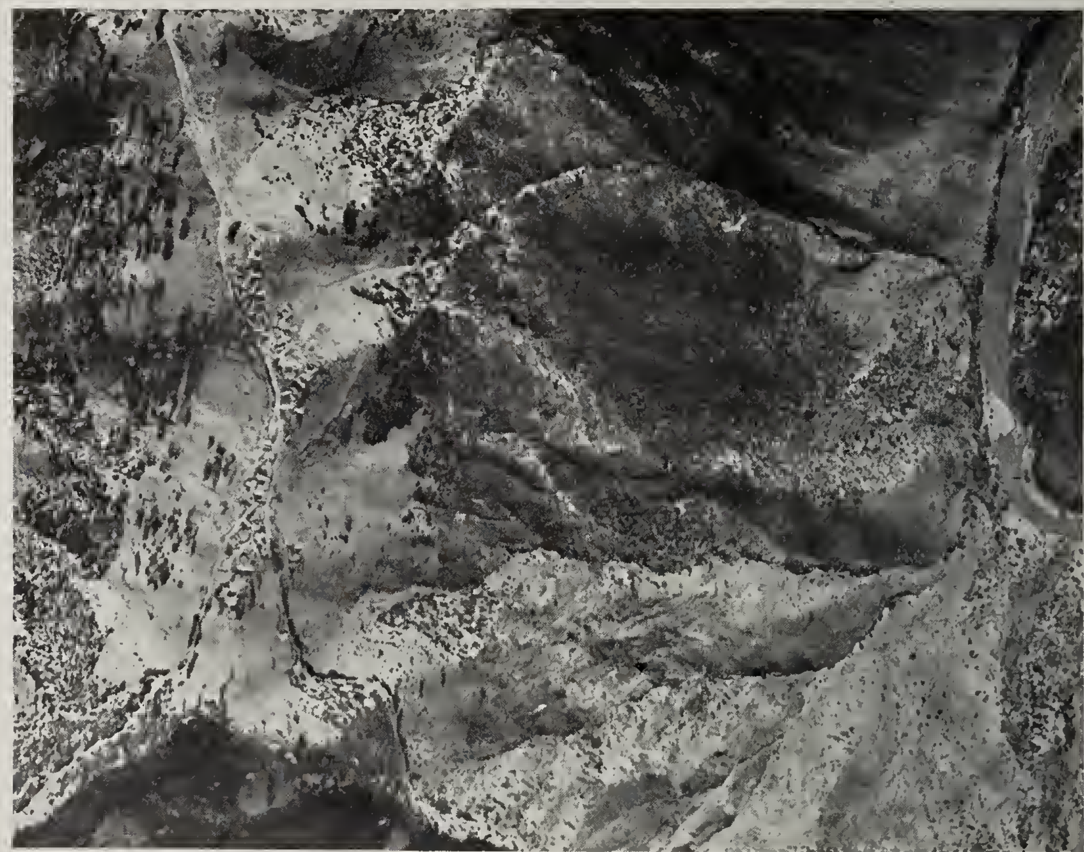

FIG. 13—"Perched" village of Kabyle type in the valley of the Amzaz, right bank affluent of the Werga. The houses are aligned along a crest which dominates the wadi on the right. The roofs are sloping instead of flat. Resources in the neighborhood of the village are meager, but the site offers advantages as a refuge. Vertical view.

the cultivation, frequently terraced, of the slopes. But the house plan, square and flanked with bastions where isolated, is entirely different from the elementary house type of Kabylia, which would appear to be restricted to the more northern mountains. Some non-irrigated cultivation of the slopes may be observed even to the borders of the Sus. To the east and south of Marrakesh in the mountain valleys live poor agriculturists with some live stock, goats in particular (they constitute one-third of the flocks in the valley of Wadi Tessut), that are not infrequently decimated by the rigors of winter. Horned cattle are sometimes stabled in winter. These people bring their cattle and wax and honey to the fruit farmers situated at the foot of the Atlas, as near Demnat for example.[15]

[15] *Bull. Soc. de Géogr. du Maroc*, No. 10, pp. 84–87.

The plains and sheltered valleys and the more eastward and drier mountains have nothing of the aspect of the *tell*. The interior valleys of the Great Atlas, to the east of the Muluya and the upper Wadi el Abid, are populated by agriculturists only in the oases, which are generally similar to those along the courses of the Saharan wadis. Nothing could be more different from the Rif with its deserted valleys and its narrow lines of houses strung along the crests than the square *kasbas* and the *ksur* (fortified villages) marking the course of the wadis and the single cultivated spots (Fig. 18).

FIG. 14—Terrace cultivation in the valley of the Wadi Amzaz. Note the dispersion of the orchards and the appearance of the dwellings—dispersed hamlets with houses of elementary type—in contrast with Figures 4 and 19 where the *dar* encloses an interior court. Vertical view.

In the Rif, where cultivations are not irrigated, the chief function of the mountain is as a condenser of moisture. Here, on the contrary, where irrigation is indispensable, it functions primarily in the prevention of loss through evaporation of the waters of the too rare rains by concentrating them rapidly in the steeply sloped valleys; that is it functions as a collector. The less important wadis gather sufficient water for the support of an oasis on the alluvial fan where the stream enters the main valley. The more important carry their benefits farther; such is the Wadi Saura, which, descending the southern slope of the Great Atlas, does not lose itself until far into the Sahara.

The mountain oasis acquires a distinctive aspect from its altitude: the date palm is absent; on the lower slopes its place is taken by fruit trees, at greater elevation by the walnut. Still higher—on the upper Muluya and

its affluents, for example, at an altitude of 1,600 to 2,000 meters—no fruit tree can resist the winter. These are the "bald" oases, treeless as the steppes which they furrow (Figs. 17 and 18).

On their exit from the mountains the watercourses do not lose their importance. Indeed it is sometimes increased, since the people of the better-watered mountain may dispense with the stream, while the agriculturists of the plain are dependent on it. This far-reaching beneficial influence is most apparent where the climate of the plains is driest. It is instanced in the galleries of palms stretching out from the mountains along Wadi Saura and Wadi Draa. The south of Morocco, in the Sus and the Huz, shows us the Atlas supporting the greater part of the plain. But as one proceeds to the north the country is enriched with water resources independent of those from the mountains. One might almost say that the great rivers of the Meseta, the Sebu and Um er Rbia, pass unheeded by the inhabitant of the agricultural plains which they traverse. Their influence is limited on their issuance from the mountains. Along the foot of the southern Atlas is aligned a series of large villages surrounded with magnificent orchards (Fig. 19) where also is water for cereals (Fig. 4). Among the Zaians each cultivator has in his turn water from a common *seguia*.

The Moroccan Mountains in the Pastoral Economy

The Rif appears to be quite like the Algerian Tell. The Moroccan Atlas resembles the latter but slightly, and in certain interior valleys changes rapidly eastward and southward to a typical Saharan landscape modified by height. As a whole the aspects of human life in the Moroccan mountains are varied, and, as we have seen, this variety is consequent on the varying usage of water for irrigation. The part played in pastoral economy is much more uniform than in the Rif. Everywhere the mountains furnish summer pasturage. Certain limestone massifs, uniformly elevated and dry, are in fact suitable for this purpose only; they are therefore dominated by the life of the plains. The Zaians from October to April winter on the Meseta, avoiding the snows of the Middle Atlas.[16] They cultivate barley and wheat on lands sometimes irrigated, where also appears an occasional fig tree or vine. Then leaving the *Azaghar*, as they term the plain, for the neighboring tribes to enjoy at their ease, they resort to the *Jebel*. Their *duars* are strung along the valleys, where they cultivate a little maize, while their flocks graze on the undergrowth of the cedar forests (Fig. 20).

These migratory movements are not common in the Rif, where from all accounts it appears that live stock is a secondary resource of the population. Probably the same is true of the Jebala. The same phenomenon appears in Kabylia. However, the extension in the Rif, especially in the eastern part, of marls and soft schists and the development of a "bad lands" topography suitable only for grazing restores in some measure the importance of pastoral

[16] *Bull. Soc. de Géogr. du Maroc*, No. 9, p. 43.

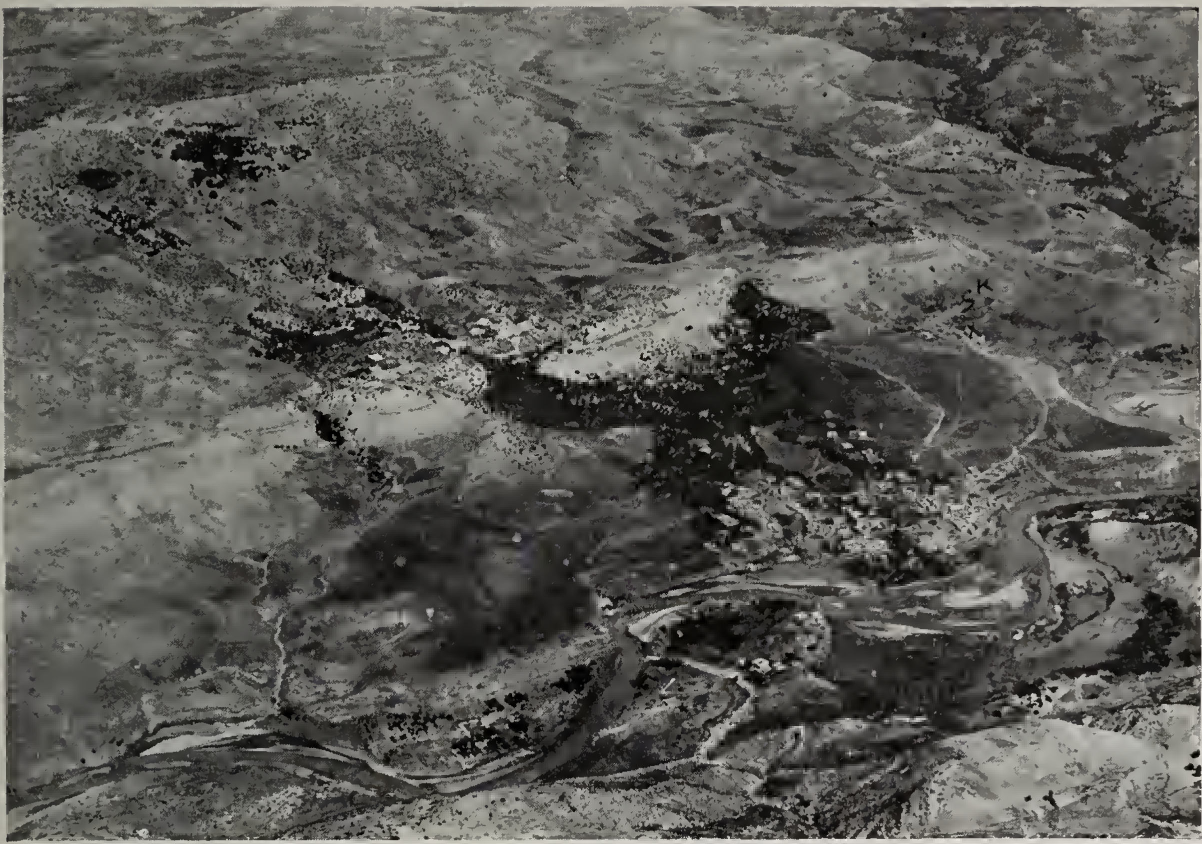

FIG. 15

FIG. 16

FIG. 15—Villages and cultivations in the valley of the upper Wadi el Abid, a little down stream from Wauizert. Altitude of airplane 3,500 meters.

FIG. 16—"Perched" villages near fields and orchards in part cultivated by irrigation. Eastern slope of the upper Wadi el Abid. Vertical view. Scale approximately 1:11,000.

life in the region. Occasionally in the Werga, for instance, the inhabitants of the hill crest villages utilize the lower valleys as pasture grounds.

The highest crests of the Atlas are frequented by the flocks in the middle of the summer. At elevations over 3,200 meters, not far from the patches of snow unmelted still in the August sun, the writer has often seen stray tents in these high solitudes.

Fig. 17—Oasis on an alluvial fan where a gorge opens onto the plain of Muluya. A little to the north of Itzer. Two *ksur* (fortified villages) can be distinguished on the nearer and farther edges of the fan. Altitude of airplane 3,500 meters.

The Moroccan Mountains as a Refuge

It is commonly known that the Algerian mountains have served time and again as a refuge for the Berber populations. The Kabyles occupy a massif which they have been well able to defend, but at the same time they suffer from overpopulation. The Moroccan mountains, broader and with higher relief, have likewise afforded refuge for ancient populations. The mountains have never been subjugated; their people have never paid the imposts of the Sultans. Today the traditional rôle is continued in the bitter opposition offered to French and Spanish penetration. On the other hand, the mountaineer frequently sets out from his refuge to seek his fortune in the plains. It was against the neighboring Berber tribes that the walls of Meknes were designed, though they have not always proved invulnerable.

How has this aspect of mountain influence affected the people? In the first place there is the marked contrast between the northern plains—where, save for the walled cities, the population has a seminomadic air—and the mountains, where human establishments in general appear more stable and

more highly individualized. Far from the routes of invasion and the exactions of the fiscal authorities, the independent tribes of the *Bled Siba* form a superabundant population by comparison with the *Bled Makhzen*. Their relatively large number, in combination with a spirit of independence, is doubtless one of the causes which have retarded French penetration in the mountains, parts of which are still not subjected.

Fig. 18—"Bald" oasis of unknown name in the mountains of the High Atlas, valley of the Anzegmir, about 70 kilometers above its junction with the Muluya. Juniper (?) bushes on the slopes. Altitude of airplane 4,100 meters.

The example of the Rifian valley of Tarzut, chanced upon in an aerial exploration of the unconquered country, is highly suggestive of this rôle of refuge. To the north of the valley of Werga, beyond the villages which control it from a little distance, one passes into a brush-covered country apparently absolutely deserted over a zone 25 kilometers broad. Traversing this one arrives at the foot of the high summit of Tarzut (2,459 meters), where in a recess of the mountain an astonishing sight greets the eye. For a space of 5 kilometers a marquetry of minute patches of cultivation covers the alluvial fans which encumber the narrow valley (Figs. 21 and 22). Orchards, a scattering of tiny dwellings with pointed roofs, and terraced cultivations on the highest slopes combine to make a little world complete in itself and remote as possible from the plains. No need for the inhabitant of the Tarzut valley to seek security by high walls, by mobility, or by strategic position: he finds it in his retired situation. According to report these mountaineers are extremely industrious: they fabricate weapons and cloth for use as exchange commodities. This protective rôle is not played,

FIG. 19

FIG. 20

FIG. 19—Orchards at the foot of the Middle Atlas on the border of the plain of Tadla. Vertical view. Scale approximately 1:6,000.

FIG. 20—The Middle Atlas to the east of Mrirt. Calcareous plateaus of slightly folded strata; forests of cedars and clearings. Altitude of airplane 3,500 meters.

FIG. 21

FIG. 22

FIG. 21—A part of the overpopulated valley of Tarzut in the heart of the Rif. Note the terrace cultivation, sometimes carried to high elevations on the slopes. Altitude of airplane 3,000 meters.

FIG. 22—Vertical view of a part of the Tarzut valley showing the crowded villages and the extreme fragmentation of the cultivated land.

however, by all the mountainous regions of Morocco. As we have seen, the Zaians, who claim a part of the Middle Atlas, use it for the practice of transhumance. The valleys of the High Atlas and all the basin of the Muluya are occupied by *kasbas* and *ksur*. But certain aerial photographs, such as Figure 14, show open agglomerations situated in the heart of the Atlas. It should, however, be remarked that each house is in plan the hollow square, a primitive fortification. Another suggestive example comes from the same region: the village of Wauizert, chief place and market of a mountain canton, is situated at the bottom of a valley in which it is the most elevated agglomeration. As for the *pays insoumis* of the central and northern Atlas, when they are better known they will furnish a yet greater diversity of illustration of human existence secreted in mountain fastnesses far from the troubled life of the plains.

A CONTRIBUTION TO THE GEOGRAPHY OF ALBANIA

By Ernest Nowack

This contribution to our knowledge of Albania is made as a result of my researches during the war when I was engaged in geological reconnaissance in that country. The prosecution of my duties took me by ways on which few explorers had previously set foot and afforded unusual opportunity for observations on the Albanian himself as well as on his land. For the most part these travels were confined to central Albania, that is the region between the Mati and Semeni Rivers, and to southern Albania north of the Voyusa. It is this part of the country that is dealt with here. On a physiographic basis I divide it into Lower Albania, the Malakastra, and Inner Albania; and I shall treat first of physical and then of human aspects of what is the most densely settled and economically valuable part of Albania.[1]

Lower Albania

The term "Lower Albania" designates a strip of land between the coast and the Inner Albanian mountains from the Mati River southwards, in which direction it gradually broadens. It is occupied by hills and low mountains with intercalated plains. South of the Semeni the typical landscape of Lower Albania gives way to a region of higher relief passing into the mountain ranges of Epirus.

Geological Structure

The whole of Lower Albania is built up of Tertiary material, all stages from Eocene to Pliocene (the latter often with gradual change to the Pleistocene) being developed. The chief rocks are slightly consolidated sandstones and conglomerates, and clays and marls of marine and brackish origin. Especially common is the flysch which here is characterized by the regular alternation of thin bands of sandstone with indurated marl and clay.

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[1] This paper does not profess to be a rounded geographical description but is a survey of the writer's own observations so far as they are of geographical interest. Only occasionally is reference made to the observations of others. Such references include the following:

Relazione della Commissione per lo studio dell' Albania: Studi geologici (Giorgio Dal Piaz; Antonio De Toni); studi geografici (Roberto Almagià), Part I, Soc. Italiana per il Progreso delle Scienze, Rome, 1915.

Ekrem Bei Vlora: Aus Berat und vom Tomor (Zur Kunde der Balkanhalbinsel I, Reisen und Beobachtungen, Vol. 13). Sarajevo, 1911.

Praschniker and Schober: Archäologische Forschungen in Albanien und Montenegro, *Denkschriften Kaiserl. Akad. der Wiss. in Wien*, 1919.

Camillo Praschniker: Muzakhia und Malakastra, Archäolog. Inst. Wien, 1920.

Ludwig von Thallóczy: Albanisch-Illyrische Forschungen, 2 vols., Munich and Leipzig, 1916.

Morphology is dealt with more comprehensively in the author's paper "Morphogenetische Studien aus Albanien," *Zeitschr. der Gesell. für Erdkunde zu Berlin*, 1920, pp. 81–117.

For a map showing central Albania in relation to the whole country see that accompanying "Albania and the Albanians" by H. Charles Woods, *Geogr. Rev.*, Vol. 5, 1918, pp. 257–273.

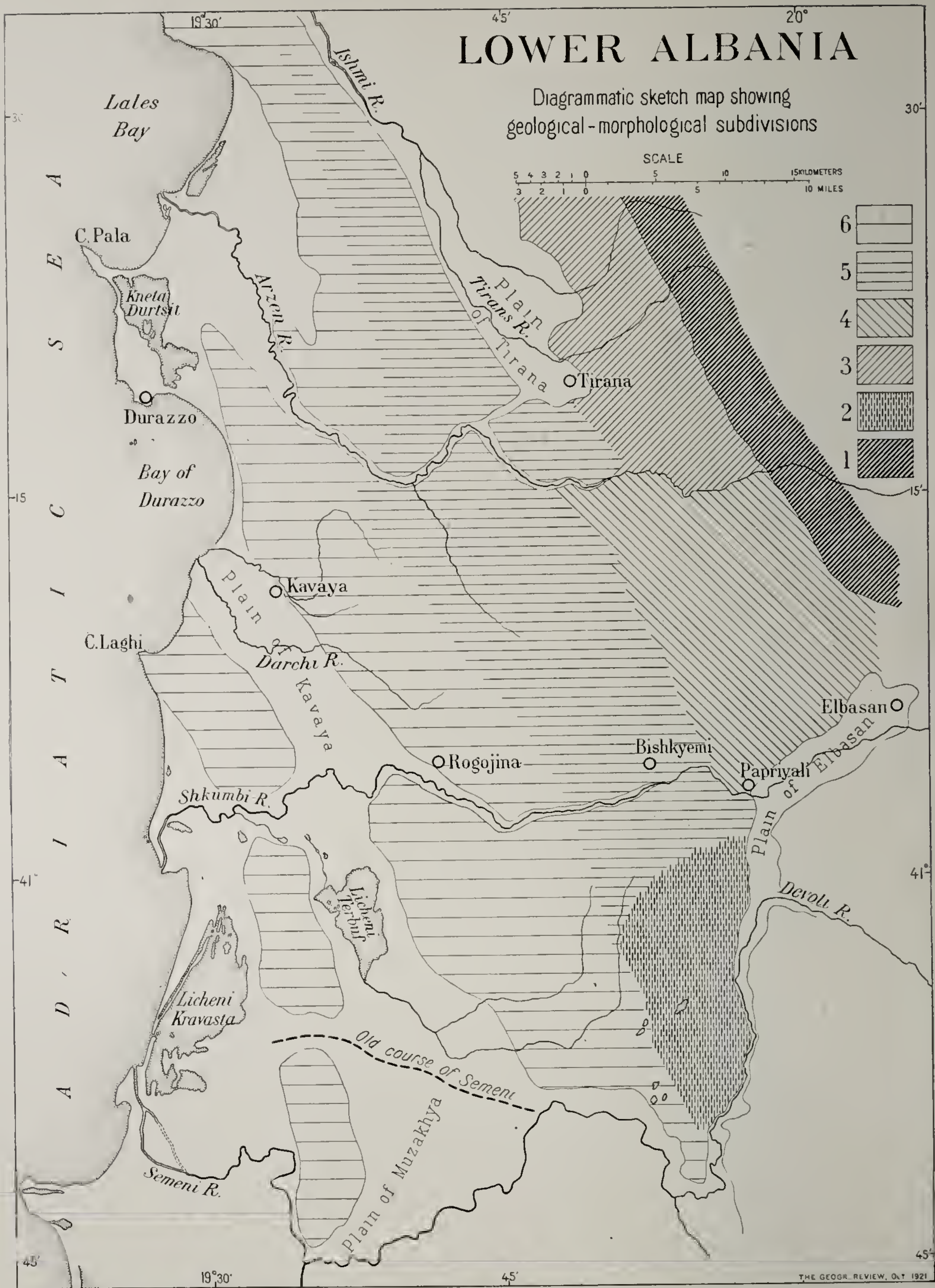

FIG. 1—Diagrammatic sketch map of Lower Albania showing geological-morphological subdivisions. Scale approximately 1:560,000. Reference to numbers in key: 6, low hills (to 200 meters), near the coast, composed in the main of Pliocene deposits and of youthful morphological character; 5, higher hills (to 500 meters) Miocene and younger flysch (Oligocene-Miocene) in a more advanced morphological stage; 4, higher mountains (to 1,000 meters) in general flysch and of a early-mature morphological stage; 3, escarpments of Tirana, flysch, Miocene (shore facies), and lowest Pliocene strata (brackish shales); 2, lake plateau of Belis, young shallow karst; 1, limestone chain of Mali Daytit of Cretaceous-Eocene age.

In the uppermost Miocene occur thin beds of lignite, economically of no more than local interest. The series is highly fossiliferous, and it has proved possible to make a detailed subdivision of the deposits, which, as Dal Piaz and De Toni have pointed out, are quite similar in their development to the Italian deposits of the same period.

Everywhere the Tertiary deposits of Lower Albania are disturbed by folds, fractures, and overthrusts. Broadly speaking, the rock structure may be described as characterized by two great anticlinal regions with intervening synclines. The folding process set in with the middle of the Miocene and continued into the Quaternary. It was the elevation attendant upon folding that brought Lower Albania above sea level; and the uplifting process appears to be active even at the present time.

Land Forms

On the whole, the topography has developed sympathetically with respect to the structure. The grain of the country trends from north-northwest to south-southeast, meeting in an acute angle the shore of the Adriatic which in this latitude trends from north to south. The hilly zones correspond to the anticlines and form promontories on their seaward ends—Capes Rodoni, Pala, Laghi—between which the shore retires in flat bays, marshy for the greater part and characterized by lagoons, barrier beaches, and dunes. Inland wide plains (corresponding to the synclines) extend from the bays—the Ishmi plain and the plains of Kavaya and Muzakhya. Morphologically this coast is in sharp contrast with the remaining part of the western coast of the Balkan Peninsula which trends northwest to southeast and is a type of depressed coast with steep shores.

Owing to the slight resistance of the generally unconsolidated Tertiary deposits the landscape of Lower Albania is superficially mature, with well-molded and completely integrated hill slopes and large open valleys especially near the shore. In the hill zones bordering the shore are little-dissected tectonic forms (anticlines) which have the gradients of maturity but which are really youthful. Inland from the coast the forms depend not so much upon the disposition of the original folds as upon the relative resistances of the rocks. Here the elevations are greater and the topographic texture is coarser, as in the Shkumbi territory. Thus certain differences in the scenery are not a consequence of differences in stages of topographic development but of different elevation and lithological character.

The stage of early-mature dissection which marks the inner portion of the shore belt known as Lower Albania is distinctly expressed in the escarpments that constitute the foreland of the Inner Albanian mountains east of Tirana. Here subsequent development of the valleys is in a beginning stage; obsequence and resequence are scarcely exhibited at all.

"Bad lands" form a local feature of the scenery of Lower Albania and give it the characteristic stamp of early maturity. They are mostly developed on

FIG. 2

FIG. 3

FIG. 2—The low hill country (Pliocene) near the coast is in a youthful stage of morphological development. Photograph in the Licheni Terbuf region.

FIG. 3—Typical landscape in the hill country (Miocene) between Tirana and Durazzo. Morphological development further advanced.

FIG. 4

FIG. 5

FIG. 4—Characteristic forms of weathering in the Pliocene sandstone of the escarpments of Tirana.
FIG. 5—"Bad-lands" topography in the flysch of the Tirana escarpments.

the flysch, especially where it is composed of easily destructible shales and clays; but they were also observed in the Pliocene marls and clays near the shore, for example at Cape Laghi. Lithological character, however, is not the sole determinant of the "bad-lands" topography. Climatic conditions—a period of intensive rainfall in autumn—and deforestation also play a prominent part.

Finally there is an area in Lower Albania where erosion takes place not in a normal way but in a manner characteristic of the karst. This area is a table-land (lake plateau of Belis) of low elevation west of the Devoli valley.

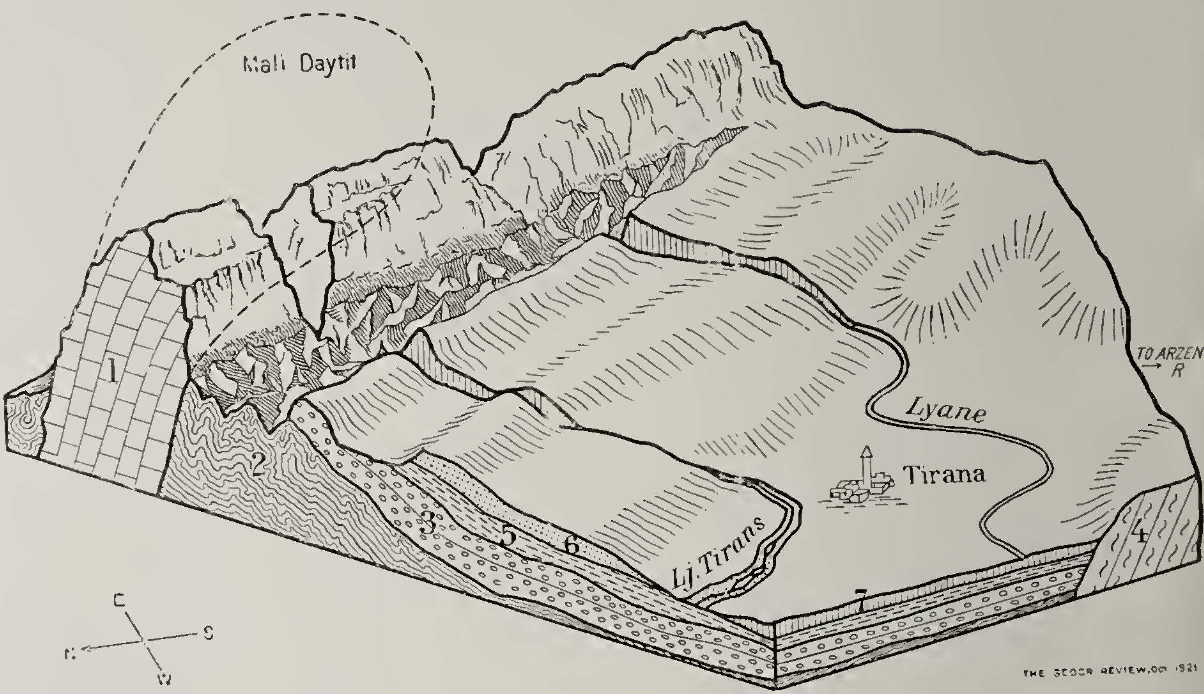

FIG. 6—Block diagram of the eastern margin of the Tirana plain (escarpments of Tirana). Reference to numbers: 7, alluvium; 6, lowest Pliocene sandstone; 5, uppermost Miocene (brackish strata with lignite beds); 4, Upper Miocene sandstone; 3, Miocene (in shore facies east of Tirana); 2, older flysch (in general Eocene); 1, limestone (Cretaceous-Eocene age).

The prevalent rock is a gypsum-limestone (probably of Lower Miocene age). The surface is marked by many small lakes in sink holes, and there are residual hills rising above the general level. This karst land has the distinctive stamp of youth. The sink holes are still separated by large interfluvial spaces.

The recency of uplift is shown in the character of the rivers and river terraces. In the plains of Shyak (lower Arzen), Kavaya, and Muzakhya the rivers are eroding strongly: Arzen, Darchi, Shkumbi, Semeni, Yanitsa flow in steep-walled beds entrenched to depths of six to eight meters. Exceptionally there are seen the effects of local movements of depression.

An interesting hydrographic feature is exhibited in the strange divide between the Shkumbi and Devoli near Elbasan. Here the two main rivers of central Albania, whose headwaters and mouths lie far apart, approach to within a distance of seven kilometers in an almost wholly plain country. The plain of Elbasan, about 16 kilometers long and not quite one kilometer

broad, corresponds to a transverse tectonic depression. The Devoli just touches the southern margin of the plain and then turns away in a sharp bend. The Shkumbi after traversing the plain pursues its antecedent course across the mountain region on the west instead of using the open way to the south.

The early Pliocene Shkumbi had a full mature valley the bottom of which can be identified as far as Inner Albania. It flowed in the direction of the present plain of Elbasan and the lower valley of the Devoli, discharging into

FIG. 7—In the middle ground the escarpments of Tirana (the nearer slopes Pliocene sandstone zone, the farther lithothamnic limestone zone); beyond, the wall of Kruya surmounted by the Miocene platform (see Fig. 27), and the summits of Mali Daytit.

a bay in the vicinity of what is today Berat. Here Pliocene deposits have been recognized by Dal Piaz and De Toni. At the end of the Pliocene or the beginning of the Quaternary the section of the valley which today is represented by the plain of Elbasan was submerged below the base level of erosion by tectonic sinking[2] combined with fracturing, and a lake was formed.[3] The lake was short-lived, being partly filled up by aggraded matter and partly captured from the west by a headward eroding coast river. The Devoli encroached upon the territory of what was the lower part of the Shkumbi, and in the now unused stretch of valley between the elbow of capture and the former mouth of the Devoli the present divide was formed (Fig. 8). It is interesting to note that the Shkumbi, owing to its shorter course

[2] Of this were found numerous geological proofs which cannot be detailed here. The plain is a landscape "drowned" in débris.

[3] According to Dal Piaz and De Toni Quaternary lake deposits are laid bare by cutting of the Devoli at the southern end of the plain.

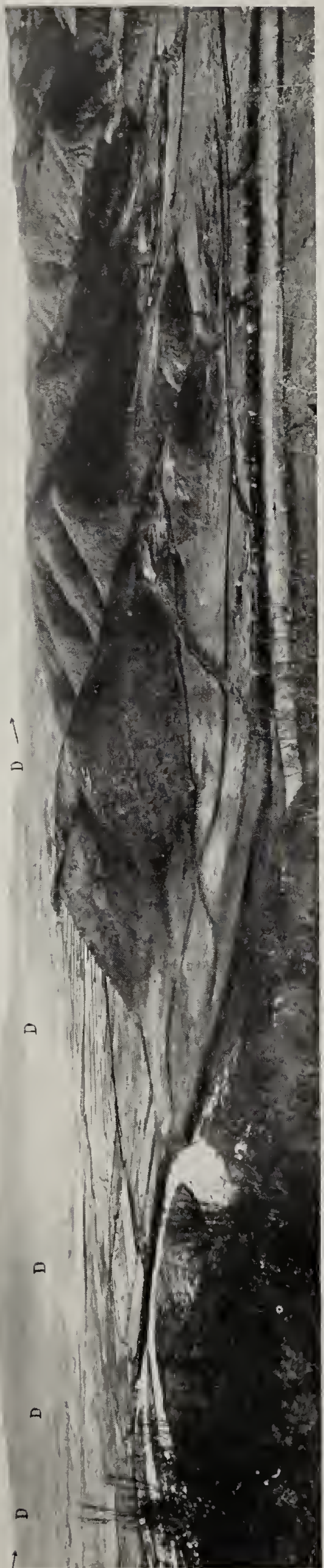

Fig. 8—The Shkumbi leaving the plain of Elbasan to cross the hills to the west. The photograph shows the present divide (D) between Shkumbi and Devoli. Note also the subdued forms of the bushwood-covered hills.

and steeper gradient, is now the stronger river and is likely to encroach wholly upon the Devoli; so that the vacant part of the valley will again be occupied by a river, but one flowing in the opposite direction, while the lower valley of the Devoli will be abandoned.

Differential uplift is exhibited in the discordance of levels of river terraces not only of various rivers but in different sections of the same river. On the lower Shkumbi between Papriyali and Rogojina two levels of terraces may be recognized. The Shkumbi valley is here composed of wide tracts of mature character and of short narrows of youthful stamp, a feature which cannot here be attributed to lithological differences. Above Bishkyemi the lower level extensively strewn with gravel is developed 10 to 15 meters above the river. Downwards where the valley is wide the level, according to Almagià, is developed at a lower elevation, and the terrace is supposed by him to be alluvial. Furthermore, especially in the narrows, remnants of gravels were found 30 to 40 meters above the river on sloping plains. Near Bishkyemi is a well developed gravel-strewn plain extending for a kilometer in length and sloping from about 50 to 60 meters relative height to about 30 meters in the direction of the river. Almagià notes a longer terrace at a height of about 40 meters. All these remnants of higher terraces appear to belong to a single old bottom which has been strongly warped. On the Kavaya rivulet are one-sided terraces that indicate a one-sided uplift, a continuing growth of the anticline at the expense of the syncline.

Vegetation

Generally speaking, the vegetation of Lower Albania with its inconsiderable elevation and exposure to maritime influences belongs to the Mediterranean province. It is characterized by the occurrence of evergreen plants including that typical formation the so-called maquis, and of certain cultivated plants, especially the olive.

From a geographical point of view the writer would class the types of vegetation as follows: (1) deciduous timber forest, (2) deciduous bushwoods, (3) evergreen shrubs (maquis), (4) heath and grassland with shrubs, (5) cultivated grounds, (6) neglected plantations (above all, the neglected olive plantations), (7) deserts.

In Lower Albania these types of vegetation prove to be chiefly dependent on geological conditions (chemical and physical qualities of soil), topography, and situation relative to human settlements.

Timber Forest

Timber forest is found in few parts of Lower Albania, though where found the forests are often extensive. It is confined to the marshy lowlands near the coast and to the heights of the more distant mountain regions. Evidently these forests are only the remnants of a once more extensive cover preserved in the less accessible regions. In places the soil also seems unsuitable for the development of a forest vegetation. In the flysch, a formation here widely distributed, scarcity of water ranks above all other unfavorable factors. Only where coarser sandstones and conglomerates are intercalated in the almost impervious strata, as in the region south of Shkumbi near Papriyali, do we find forest growth on this formation.

Besides the marshy alluvial lowlands round the river mouths the soft (Upper Miocene) sandstones which occur largely in the country between Tirana and Durazzo also seem favorable to the growth of a luxuriant forest vegetation. The most beautiful forests seen by the writer were on the one hand in the lowland of the Mati River and on the other hand on the heights to the south of Cape Rhodoni. The lake plateau of Belis also has an extensive timber forest.

The forests of Lower Albania are composed almost entirely of oaks. Everywhere there is a dense undergrowth of ferns, ivy, and creepers, mostly spiny. All the forests are in a primeval state.

Bushwood

By far the most generally distributed form of vegetation in Lower Albania is the deciduous bushwood. Together with the belts intervening between it and the scant ground cover of the desert lands it may occupy two-thirds of the area. Its chief components are various species of oak (among them *Quercus coccifera*) and beech. Their stunted growth is probably due to the age-old abuses of man and the browsing of goats. In

spring the bushwoods are bright with an exceedingly rich flora—crocuses, violets, anemones, and the like.

Maquis

Maquis occupies comparatively little ground in Lower Albania. Its dependence on soil composition is marked. I found it distinctly confined to a soil rich in iron and silica but dry and poor in humus. It thrives well on the coarse ferruginous quartz sandstones and quartz conglomerates such as appear in a middle horizon of the flysch.

The most important forms of the maquis here are: tree heath (*Erica arborescens*) and oleander (*Nerium oleander*); then an ash (*Fraxinus rostrata*), the mastic tree (*Pistacia lentiscus*), juniper, *Phillyrea*, and broom. More rarely I found myrtle, the strawberry tree (*Arbutus Unedo*), holm oak, and others.

One of the most extensive maquis forests of Lower Albania appears on the zone of Lower Pliocene sandstone in the escarpments of Tirana. Whereever these sandstones outcrop they are covered almost exclusively by tree heaths and oleanders of a rare luxuriance, a feature which contributes much towards the distinctive physiognomy of the landscape. Elsewhere I found a continuous maquis cover only in the hill country on the border of the plains (east of Kavaya and the Muzakhya). Here in one place I also found yucca growing wild. Some elements of the maquis, especially the tree heaths, appear not infrequently mixed with deciduous trees. Such a type of mixed forest is especially common in the country between Tirana and Durazzo.

Heath and Grassland and Marsh

Evergreen as well as deciduous forests often pass into heath; and this form of vegetation, widely spread in Lower Albania especially on the hills near the coast, is again intimately connected with grassland and pastures. The rockrose (*Cistus*) with its splendid red and white blossoms, then rosemary, and sage are dominant in these heaths. Thickets of juniper, broom with its bright yellow flowers, thorns (*Crategus*), and again the tree ericas make a characteristic appearance in the heath. Of other plants special mention must be made of the asphodel (*Asphodelus ramosus*). In certain areas its immense numbers make it the most striking feature of the spring landscape.

The same shrubs and plants are met with again in the grasslands which are mostly connected with the heath but also are not infrequently interrupted by cultivated ground. But, whereas the heaths apparently favor the dry slopes with sterile soil (sandstone and conglomerate), the grasslands extend into the lowlands where they are associated with a swamp vegetation. Grassland as well as heath predominates in the coast regions especially in the plain of Kavaya about the Licheni (Lagoon) Terbuf where, often interspersed with juniper, it ascends the flat hills towards the east.

In spring the grassland with its luxuriant green and its many blossoming shrubs presents a splendid appearance; but in summer, when all is dry, withered, and yellow, it has a monotonous character, and then this landscape with its expressionless forms is one of the most unattractive in Albania.

Marshy vegetation is prevalent not only in the wide stretches of lowland about the shore but also in the interior plains, which are flooded during the rainy season and far into the spring. Round the lagoons large areas are occupied by rushes (*Scirpus*, *Phragmites*, and *Typha*); in the interior plains various hard, tall, bog grasses predominate (*Polygonum*, etc.).

FIG. 9—Bushwood and grassland with asphodels in the hill country near the coast.

Cultivated Ground

Extensive areas of cultivated ground are found only in the plains round the larger settlements and in the larger valleys. Elsewhere are seen only single strips of fields interspersed between bushwoods, heath, or grassland and most particularly in the bottom lands of the smaller streams and brooks. The best cultivation is carried on in the plain of Tirana and the Muzakhya in the environs of Fyeri, the only sections where large estates are to be found. The lower valley of the Arzen, the valley of the Shkumbi below Bishkyemi, and that of the Semeni are also mostly occupied by cultivated ground.

The chief grain cultivated is maize; rye, barley, and oats are also grown, but in smaller quantities; and in some parts rice is grown, as in the Semeni valley.

The small fields of the peasants are almost always surrounded by hedges, in whose rich vegetation may be noted the pomegranate tree, conspicuous by its bright blossoms, and the Judas tree (*Cercis siliquastrum*). The arable

land itself, especially on the slopes, is well stocked with cultivated trees, above all the olive; then the fir, mulberry, walnut, and plum; more rarely the pear and apple. Orange trees are found here and there; but considerable groves are seen only in Elbasan, which has an exceptional climate. Round the settlements and in certain towns, such as Tirana and Fyeri, we find much land in gardens.

Fig. 10—Olive trees in the neighborhood of Tirana.

Notice must here be made of the solitary trees, preserved with solicitous care because of their shade value and their beauty. There are gigantic planes of many meters' girth and huge spreading branches. Tirana boasts a famous grove of such trees. As in the whole Mediterranean region, the cypress is a characteristic tree planted mostly as guardian of sanctuaries and shrines. The stone pine (*Pinus pinea*) is not common, but its peculiar umbrella-shaped crown is distinguishable at long distances. In the environs of Tirana and elsewhere the pyramid poplar (*Populus pyramidalis*) is planted

in long avenues and beside ditches. Neglected olive plantations are widespread in Lower Albania, extensive groves occurring in the neighborhood of the larger cities. Neglected vineyards are also seen; but, whereas one might attribute their condition to the Islamic religion, the complete neglect of the olives can only be considered as a proof of the great retrocession in culture that has taken place in recent centuries.

Deserts

Deserts in Lower Albania are confined to the flysch. The causes of the poverty of the vegetation have already been mentioned. The extreme cases of the "bad-lands" topography are entirely destitute of vegetation or at most support only single shrubs, chiefly junipers. Here conditions for vegetation have been unfavorable from the beginning, and reckless cutting down of such woods as existed has laid these regions as completely waste as the karst lands of the Mediterranean. In the Krabe Mountains particularly there are wide stretches of this poor country almost entirely deprived of vegetation.

The Mountain Country of the Malakastra

The Malakastra comprehends the country extending from north to south between the Semeni and Voyusa Rivers and east to west from the Ossum to near the Adriatic. Already a hilly country on its seaward border it steadily increases in height towards the interior and rises on its eastward border to a difficultly accessible mountain region with very few passes. In respect of its physiography as well as its civilization the Malakastra belongs to southern Albania.

Geological Structure

Geologically there is a rather close affinity between the Malakastra and Lower Albania. From this point of view the region is a transition area towards the mountain regions of southern Albania and Greek Epirus. The Malakastra, like Lower Albania, is underlain by Tertiary deposits except in the anticlines of the eastern Malakastra where older strata outcrop.

The marly and fossiliferous sands, conglomerates, and clays of the Pliocene in the westernmost Malakastra lie in the attitude of flat domes, whose axes strike from northwest to southeast. Towards the interior the intensity of the structural deformation increases; and, besides a steep inclination of the strata, there has been extensive fracturing along which overthrusts of older over younger strata have taken place. Towards the east the folding begins to assume a more meridional direction and at the same time a more compact orography with well-marked ridge lines. Here in the Middle and Upper Miocene solid resistant rocks, notably the lithothamnic limestones, appear and exert a marked influence on the modeling of the relief. Still farther towards the interior the characteristic structure of the eastern Malakastra begins. It is composed in the main of four great limestone anticlines (Cretaceous to Eocene) running parallel from south to

north with intercalated flysch in the synclines, intensely crumpled and plicated in detail. The two easternmost of these have their direct continuation in the folded Epirotic chains. In the south of eastern Malakastra appears a Neogene basin the eastern part of which has been overthrust by flysch. This marks the third and most important line of disturbance in the Malakastra. I could trace it northward for a distance of 30 kilometers, and it probably continues southward into the Voyusa valley.[4]

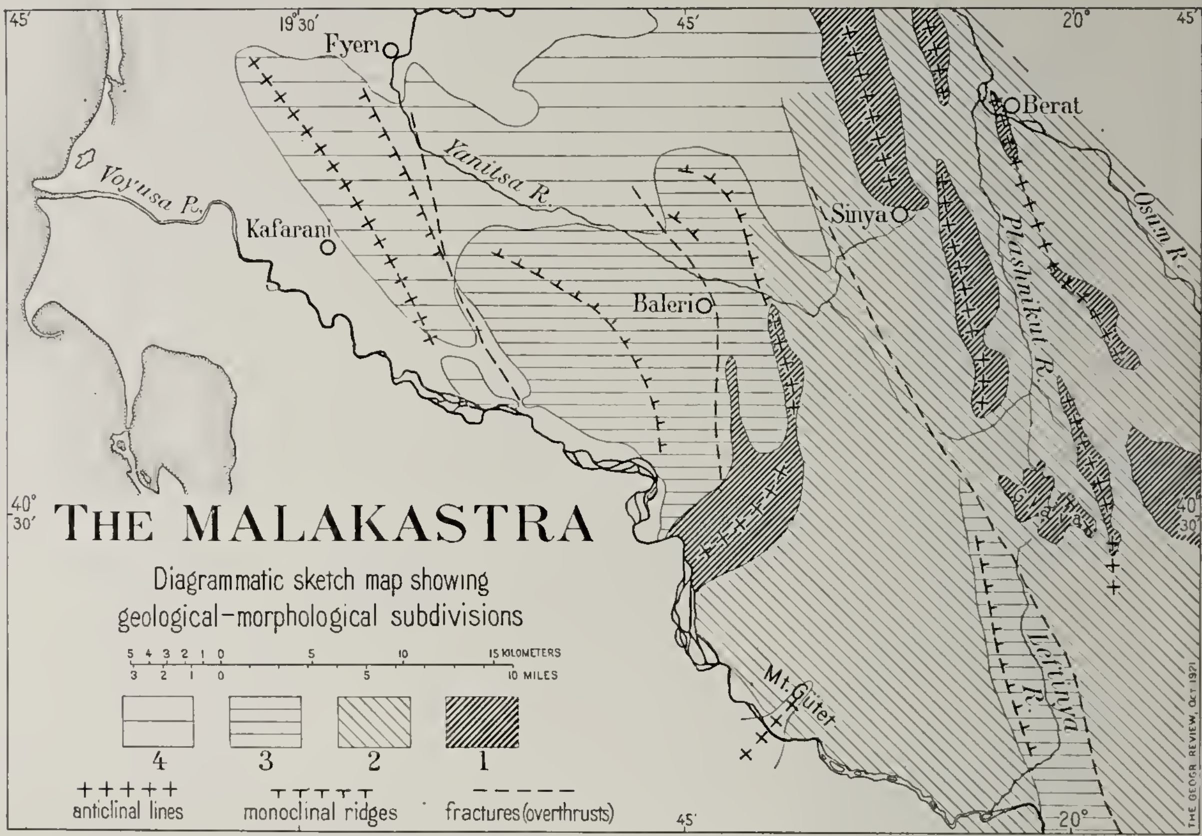

FIG. 11—Diagrammatic sketch map of the Malakastra showing geological-morphological subdivisions. Scale approximately 1:560,000. Reference to numbers in key: 4, low hill country of the westernmost Malakastra (to 300 meters) in general of Pliocene strata and of youthful morphological character; 3, higher hills (to 600 meters) of Miocene (Ostrea sandstone, lithothamnic limestone, and upper flysch) in more advanced stage of development (zone of monoclinal ridges); 2, flysch, partly "bad lands"; 1, anticlinal ridges of basal Malakastran limestone of Cretaceous-Eocene age.

It is evident that the tectonic processes in this region operated at the beginning of the Neogene, somewhat earlier than in Lower Albania, and similarly lasted without any considerable interruption into the Quaternary. The intensity of disturbance as well as the degree of erosion of the older strata show that the folding process progressed towards the north and west, in longitudinal as well as transversal direction, that is to say the folding of the Malakastra and Lower Albania is a continuation of the development of the Epirote mountains which were raised by folding in the Paleogene in a direction towards the Adriatic geosyncline.

[4] While this article was in the course of preparation newspaper despatches reported an earthquake here. It is probably connected with this young disturbance and is indicative of the present continuance of tectonic activity in the Malakastra.

Morphological Development

As in Lower Albania, the landscape as a whole must be considered in an early stage of the geographical cycle. True, in many areas characteristic features of youth are wanting; but this may be explained in part by the incapacity of the marls and clays to preserve youthful forms for any length of time and in part perhaps by the fact that uplift has progressed so slowly that the leveling forces have had time to obliterate earlier features. In western Malakastra, however, we find the well-marked features of youth. The streams run in sharply entrenched valleys often entrenched in older and broader flats—a condition which, as in Lower Albania, points to a development in subcycles or episodes. The mountain slopes are furrowed by steep, deep-cut ravines; and landslides are of frequent occurrence.

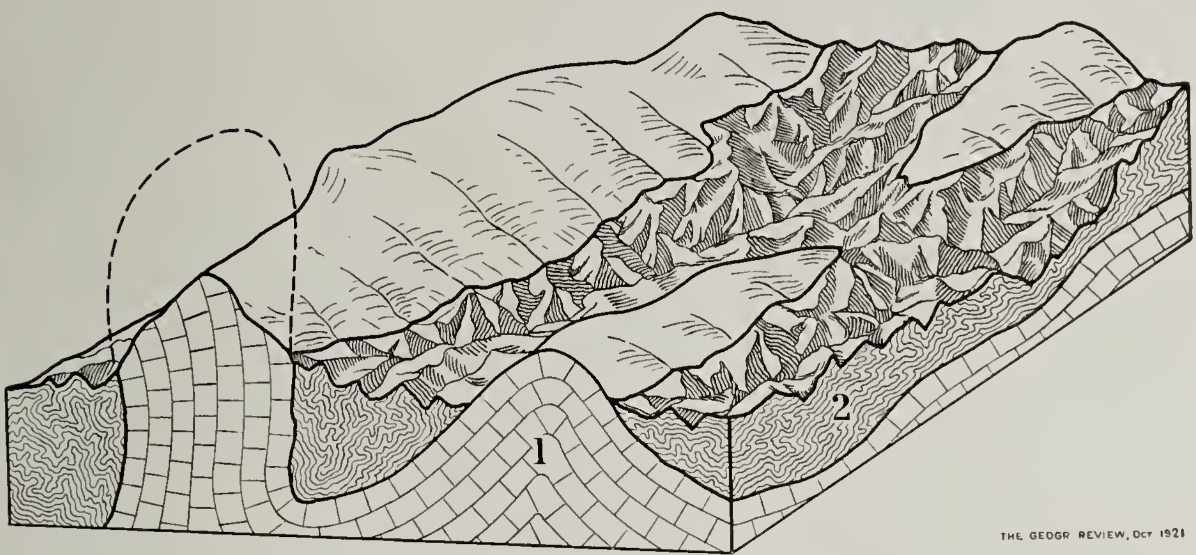

Fig. 12—Block diagram of typical country in the eastern Malakastra. Reference to numbers: 2, Paleogene flysch; 1, basal Malakastran limestone of Cretaceous-Eocene age.

Towards the east the landscape passes into a higher stage of development (late youth to early maturity). The inner portions of the anticlines, here consisting of hard limestone rich in flint, are modeled out in sharp relief, the contrast with the well-molded forms of the flysch being very pronounced. In the flysch of the Malakastra "bad-lands" topography is developed to a still higher degree than in Lower Albania. Especially is this so in the eastern part of the region in the wide synclinal area drained by the Plashnikut, a tributary of the Ossum. Tectonic activity in the Malakastra is seen in the hydrographic changes that cannot be explained by development in a normal, undisturbed cycle. There is, for instance, the peculiar position of the watershed between the Yanitsa and the Voyusa in western Malakastra. It approaches close to the Yanitsa, the entire area being drained asymetrically to the Voyusa. The uppermost parts of several brooks are directed towards the Yanitsa but turn from it suddenly in sharp bends, being separated from it only by low, narrow saddles. Obviously the erosive

power of the Voyusa tributaries has been recently strengthened, and these streams have captured the tributaries of the Yanitsa. The one-sided strengthening of the erosive force can in this case be explained only by a tectonic and purely relative lowering of the local base level.

Vegetation of the Malakastra

Though the vegetation of the Malakastra is naturally largely identical with that of Lower Albania, the differences are worth noting for they show

Fig. 13—Landscape of the eastern Malakastra. An anticlinal limestone ridge (Mali Rahova) in the midst of flysch. To the left is the synclinal valley of the Plashnikut; on the right the high mountains of the Tomor. On the limestone ridge the track of a Roman road is plainly seen.

how sensitively the vegetable world reacts to geological and topographical variations.

Of the forms of vegetation existing in Lower Albania the timber forest is here almost entirely missing; scant trace is found only on the isolated heights of the southeastern Malakastra. Here, too, scarcity of water, much more marked than in Lower Albania, and devastation wrought by man are ascribed as causes.

Deciduous bushwood with the same components as in Lower Albania is the prevailing form of vegetation, and only in the western Malakastra does the maquis come to the fore. In this part of the region the maquis often attains a grandiose luxuriance. Slopes and ridges up to heights of over 600 meters are covered with thickets three meters in height. The mastic

tree and the ilex are the more conspicuous forms. The larger copses seem to be composed almost entirely of ilex whereas the mastic is found in light, parklike stands in the pastures. In the Malakastra, as in Lower Albania, the evergreen vegetation is notably confined to the porous soils rich in silica; the geology here is indeed a sure guide to the vegetation. Wherever the soil offers favorable conditions the maquis advances far into the interior; thus I found it even in the extreme east on the slopes towards the Ossum.

Here also gradual transitions lead from the maquis to the heath, which rarely occupies large areas. The grassland likewise is of limited extent, figuring largely only in the plain of the Voyusa and on the slopes of the western Malakastra towards this river.

Cultivated ground plays a somewhat more significant part in western Malakastra, though even here there are no extensive cultivated areas but mostly the small, garden-like fields of the peasantry. The olive tree, neglected here too, is very common, and the fig tree more so than in Lower Albania. The fig produces abundant fruit.

In the eastern Malakastra the cultivated ground forms no more than isles in the neighborhood of communities. In particularly favored sites fields and olive groves are found up to an elevation of from 700 to 800 meters. This is, for instance, the case in the pass of Sinya, where a fertile, residual limestone soil (*terra rossa*) occurs at the foot of the anticlinal ridge of Shpiragri. *Terra rossa* also fills the sink holes of the summit of the ridge at a height of almost 1,200 meters, and these too are cultivated despite their inaccessibility.[5] For the rest the scenery of the eastern Malakastra is dominated by bushwood in its southern part towards the Voyusa, by deserts in the north. The limestone for the most part, and the flysch as well, is barren, clothed only by shrubs, mostly juniper. In the western Malaskastra only part of the flysch and the lithothamnic limestones are barren.

Population, Settlements, and Routes of Lower Albania and the Malakastra

Lower Albania and the Malakastra are regions of ancient settlement and were once, in contrast to modern conditions, seats of a highly developed culture. In the seventh century B. C. colonies were founded by the Greeks. The pastoral Illyrian peoples who here, as in the whole northwestern part of the peninsula, formed the aboriginal population were driven back into the interior. The first cities founded were Epidamnos, later on named Dyrrhachium by the Romans, whence the modern Durazzo (Albanian, Durres), and Apollonia. Apollonia was magnificently situated on the last spur of the Malakastran ranges towards the sea, commanding the bay of Valona. Under the Romans the city became a stronghold of intellectual culture and, as a river harbor (on the Voyusa, which has since changed its course), a most

[5] Elsewhere sink holes have not been developed in the limestone of the Malakastra; and the sink-hole vegetation, so important in other parts of the eastern Adriatic coast lands, is here insignificant.

important trading center. All traces of the populous city of Augustan days have disappeared except a few insignificant remains of walls.[6] On its site stands today the picturesque old monastery of Poyani. Stones from the antique city bearing reliefs, sculptures, and inscriptions have been carried away, often to considerable distances, in the stoneless regions of western Malakastra and the Muzakhya, there to be used in the construction of buildings, especially churches.

Another great Malakastran city of antiquity was Byllis. It likewise was

FIG. 14—Typical scenery in the Malakastran mountains A group of houses, *kulas*, with old oaks on a ridge crest.

a Greek foundation on the Voyusa, placed on a commanding height 500 meters above the river and some 35 kilometers farther towards the interior. Besides remains of the encompassing walls and their towers, traces of an amphitheatre have been discovered. An inscription in its original situation makes identification positive. Undoubtedly many archeological treasures here await reclamation.

Throughout Roman rule Lower Albania and the Malakastra were in a state of prosperity. Malakastra in particular was dotted with settlements and was provided with a network of good roads.

With the barbarian invasions and the downfall of the Roman Empire the seats of culture in Albanian territory began to decline. Durazzo, indeed, still remained for some centuries an important stronghold of the Byzantine Empire; but Apollonia, mentioned for the last time in the sixth cen-

[6] Special reference should be made to the important archeological researches in central and southern Albania made during the war by Dr. Camillo Praschniker at the order of the Austrian Government. See footnote 1.

tury, disappeared altogether. The Roman and Hellenic elements gave way more and more; and in their place there began to be felt Slav influence from the north, though several monuments have been preserved from Byzantine times. In the fourteenth century commenced the Ottoman invasions from Asia and Albania's heroic age—culminating in the triumph of Skanderbeg, who with Venetian aid from Durazzo held the Turk in defiance. After his death, however, Ottoman advance was no longer to be stayed, and in the struggles that followed the last traces of the numerous, quondam flourishing

FIG. 15—The monastery of Poyani on the site of the old Roman city of Apollonia.

settlements were destroyed. Progressive decay set in, reducing Albania to that low state of culture in which we see it today. The process of Mohammedanizing began with the sixteenth century and spread rapidly. Today the Moslem element is very prominent, especially in the cities.

Present Elements of Population

We see then an aboriginal Illyrian population successively subjected to Hellenic, Roman, Slav, and Ottoman influence during the course of which the original element has been largely submerged. It is best discernible in the language; which, however, does not show even ten per cent of pure Illyrian roots. Owing to the impassable nature of the country foreign influences have penetrated very unequally. On the coast of Lower Albania Roman influences from the opposite shore of the Adriatic are still apparent, the last wave of this influence dating back to the times of Venetian rule. In the south, even in the Malakastra, Greek penetration is evident; in the

north that of the Slav. The Ottoman element is almost universal, predominating especially in the interior of Lower Albania. Particularly through religious evidences do these various spheres of foreign influence obtrude themselves upon the eyes of even a hasty traveler. In the interior of Lower Albania the minaret is seen everywhere and with the characteristic Moslem cemetery adds a distinctive note to the landscape. In the south and the north are equally typical Christian churches, the majority in ruins.

Fig. 16—A Tosk wearing the costume of southern Albania.

Today the Albanians are divided into two chief groups differing considerably in language and customs: the Ghegs in the north and the Tosks in the south. Generally speaking, the Semeni is the frontier. Lower Albania therefore has a Gheg, the Malakastra a Tosk population. In addition there are certain unassimilated elements who live for the most part in isolated colonies and are sharply differentiated by their peculiarities. Such are the gypsies and the Kutzo-Vlachs. For curiosity's sake the remains of a negro colony at Berat may also be mentioned.

Bodily and Mental Qualities

As regards physical qualities the Gheg seems highest to me as I met him in the country near Tirana. The weekly markets gave ample opportunity for admiring the forms of these tall, lithe, sinewy men attired in their becoming costume. Among the women, too, who elsewhere in Albania can hardly boast of particular charms, beautiful figures and regular features are often to be found in this part of the interior. On the contrary the population of the regions near the coast shows signs of physical degeneration, a circumstance largely attributable to malaria, the scourge of the marshy lowlands. Dress and dwellings, too, are much more neglected on the coast, and the general Albanian dislike of work is exaggerated. The population of the westernmost Malakastra also suffers considerably from malaria.

The Tosk, the inhabitant of the Malakastra, has a shorter figure than the Gheg, less sharp features, and greater mobility. In intercourse, contrary to

FIG. 17

FIG. 18

FIG. 17—The weekly market of Tirana showing the costume of northern Albania. A gypsy woman in the right foreground.
FIG. 18—Kutzo-Vlach women at Tirana.

the reserved Gheg, he shows some obtrusiveness. The bias towards the national character of the Greek is unmistakable.

As to religion the Albanian, both Moslem and Christian, in Lower Albania and the Malakastra strikes one by his extreme laxity, an external sign of which is his neglect of the places of worship and the cemeteries. Only on certain holidays is a religious feeling—much mixed, however, with profane interests—apparent. The clergy everywhere are like the rest of the people on a low stage of culture. Yet the Albanian is not wanting in intellectual capacity: even more, a genuine thirst for knowledge may be observed. Albanians have risen to high positions in the Turkish Empire, and Albanians

FIG. 19—Pottery at Kavaya. Pottery making is the most important indigenous trade of Lower Albania.

living abroad have distinguished themselves in literary spheres. In the country today the status of education is low, and the short period of independence has not sufficed to alter these conditions in spite of ardent desire for reform.

Agriculture and Trades

The chief occupation of the inhabitants of Lower Albania and the Malakastra is agriculture. But it is not developed to the extent one would expect from the general fertility of the soil, which in the plains is for the most part of very good quality, and the remarkably mild climate. In the plains wide tracts of suitable land lie uncultivated, and still more might be made available for agriculture by a simple system of irrigation. The people commonly grow only sufficient crops for their immediate needs, unimportant exception

being made in the case of certain *latifundia* in southern Muzakhya and near Tirana. The mode of cultivation is the most primitive imaginable. Rotation of crops and manuring are unknown. The commonest agricul-

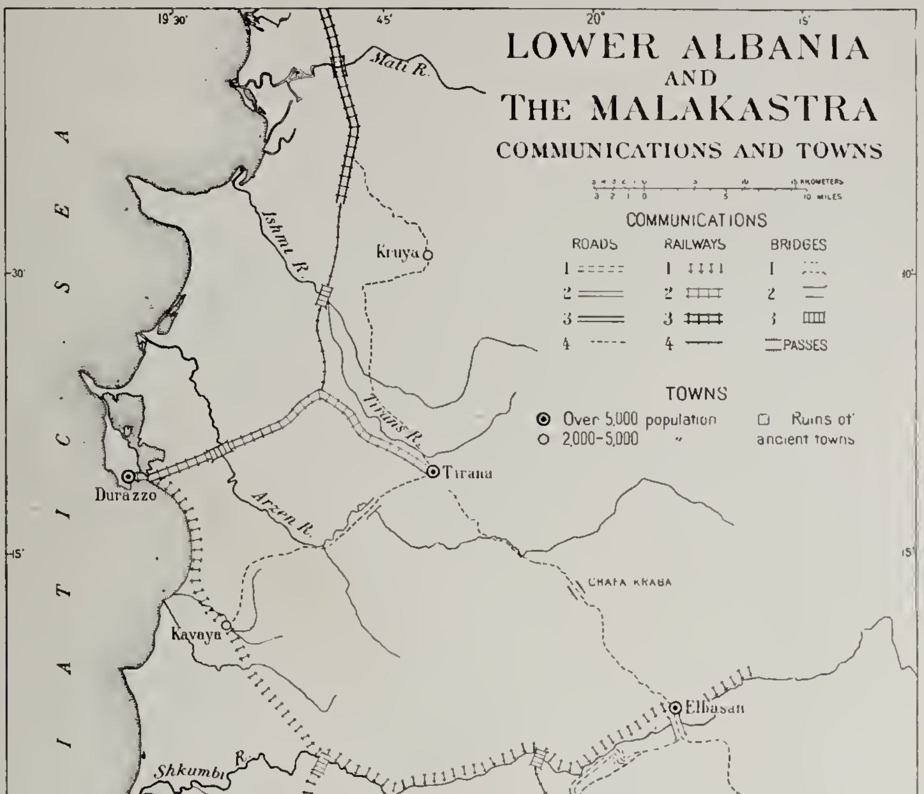

FIG. 20—Sketch map showing the most important settlements and routes in Lower Albania and the Malakastra. Scale 1:1,000,000.

tural implement is a wooden plow which loosens, but does not turn, the soil. Neglect of the olive groves, which could be made the basis of a most productive industry, has already been mentioned. There is hardly a doubt that by intensive farming Lower Albania could provision the whole of the country

and even have a considerable surplus of certain products, oil and tobacco for instance, for export.

In the more mountainous parts—in the Krabe Mountains of Lower Albania and the eastern Malakastra—grazing, more particularly of sheep and goats, becomes more important than agriculture. Here too we meet the most primitive conditions. Stables for the animals are almost unknown;

Fig. 21—Mosque in Tirana.

dairy farming is little developed. Horses, a small hardy native breed, and asses are used for riding and transport. The buffalo is commonly used as draft animal in the plains; it is harnessed to a grotesque-looking cart provided with extremely high wheels on account of the deep mud of spring.

In Lower Albania the most important indigenous trade is pottery making. In certain towns, especially in Tirana, such mechanical arts as filigree, niello and brass work, and the carving of tobacco pipes are pursued. Mag-

nificent embroideries distinguished by good taste in color and design are made by the women and sold on the market place.

Settlements and House Types

Four main types of settlements can be distinguished in our region—compact settlements, group villages, scattered mountain villages, and isolated

Fig. 22—In the inner part of the town of Berat.

farms. In Lower Albania the compact settlement prevails with, in addition, isolated farms in the plains and scattered villages in the hills. Throughout Malakastra the scattered mountain village prevails with the group village in addition.

Albanian house types fall into two classes—the stone house, *kula*, and the mud house. The town house might be added as a third type, but this is not indigenous; it shows features common in all countries that have come under Turkish rule.

The mud house, which is confined to the plains and the contiguous hill country, is most characteristic of the coastal regions. Occasional examples may be seen up the valleys of the larger rivers. The mud house is built of sun-dried bricks with a framework of crossbeams and a roof of pantiles or, because of the lack of suitable timber, of reeds over a rough support. In the most primitive forms the walls are of willow hurdles or reeds chinked and daubed over with clay. A characteristic feature of village scenery is the sharply pointed conical sheepfold of willow stakes.

The *kula*, which is the house type of the remainder of Lower Albania and the greater part of the Malakastra, is of rude stone, not even roughhewn. It is without apertures on the ground floor and above is pierced only by a few loopholed windows that confer upon it the appearance of a fortification, which indeed is to some extent its function.

Towns

Lower Albania has four towns with over 5,000 inhabitants—Durazzo, Tirana, Elbasan, and Berat—and two smaller ones (2,000 to 5,000), Kavaya and Fyeri. These only of the larger communities have an urban character.

Durazzo still remains the principal port of Albania, though the harbor is choked with sand and vessels must anchor in an open roadstead. The town with its narrow, crooked alleys of small ill-kept houses lies at the foot of Mali (Mt.) Durtsit which rises like an island out of the marshy ground. Dominating the town is the mighty Venetian fortress partly rebuilt by the Turks but today mostly in ruins. Of the buildings of antiquity none remain; sculptures, inscriptions, and other relics have been found, but none of them in their original positions. In spite of its small size (estimated population 5,000) Durazzo, because of its favorable geographical and strategic position, was selected as the capital of the late principality. It has the largest import trade in the country and is the starting point of the chief routes into the interior.

Tirana (12,000), connected with Durazzo with what was before the war the only highroad of the country, is the center of the northern part of Lower Albania. Unlike malaria-stricken Durazzo Tirana is situated in a beautiful and healthful region on the margin of a fertile plain at the foot of the mountains. Tirana is a scattering garden town centered round a rich bazaar with arcades, broad paved streets, and squares ornamented with fountains. Numerous mosques richly decorated with gaily colored Moorish ornamentation embellish the city. Founded by the Turks in the seventeenth century Tirana exhibits a rare purity of oriental architecture, and the greater part of its inhabitants are Moslem. The town is a favorite residence of certain noble families who here possess palace-like houses. Besides being a center of trade Tirana is also distinguished for its industries.

Elbasan, situated on the Shkumbi where it leaves the mountains of Inner Albania, is the largest city of Lower Albania (over 13,000 inhabitants). It

FIG. 23

FIG. 24

FIG. 23—The water gap of the Ossum at Berat, crossed by a stone bridge of Turkish build. To the right is seen a part of the lower town of Berat.
FIG. 24—The upper town of Berat.

is a foundation dating from the early days of the Ottoman invasion, the middle of the fifteenth century. The remains of a large fortification are still preserved at its center, and in general, with its plane-shaded fountains and its half-ruined mosques, the town presents an air of picturesque antiquity. According to Dr. Praschniker the Ottoman structure rests on an older foundation probably dating from Roman times. Discoveries of sculpture and an inscription also indicate an early settlement on this site. The importance of Elbasan lies in its situation where the only transverse road at all practicable for wheeled traffic enters the mountains. As in Tirana a brisk business is transacted at the weekly markets; but, whereas in Tirana industrial wares figure largely, here it is oil and tobacco, the produce of gardens, flocks and herds. Elbasan conducts the interchange of products between mountain and plain.

Berat (8,500) occupies a similar situation on the frontier between Lower Albania and the mountains of the interior. The city, which is divided into a lower and an upper town—the latter girdled by old defenses, is set in the midst of magnificent scenery. Here the Ossum forces its way in a narrow gorge through the anticlinal ridge. In the background are the steep-sloped highlands of the Tomor, snow-covered far into the summer. Berat is a bridge town. From it a longitudinal road, crossing the Ossum by a mighty stone bridge of Turkish build, leads through the eastern Malakastra towards the south. Traces of the foundation of a fortification which, in its essential features, is of Byzantine character indicate early settlement on this spot. Today Berat is the center of culture for all central and southern Albania. To its sphere of influence in particular belong a great part of the Malakastra, and the valleys of the Semeni, Ossum, and Devoli. The population is almost purely Tosk, though here in the south the Greek Orthodox element begins to enter.

Fyeri is a local center for the southernmost part of Lower Albania, the Muzakhya, and the western part of the Malakastra. Its 2,000 inhabitants include a strong Greek Orthodox element. Fyeri is a garden town with a small commercial quarter where picturesqueness is spoiled by several ugly west-European buildings.

The Malakastra has no towns today although in classical times it boasted two large cities, already described, and numerous smaller settlements and fortresses.

Communications

In briefly hinting at the conditions of traffic emphasis must first be laid on the extensive network of ancient roads, of which numerous traces have been preserved and which present the sharpest contrast to modern conditions. It is true that considerable transformation was effected during the war, but one may doubt whether this improvement will last.[7]

[7] For an account of improved communications in southern Albania effected during the war see George P. Scriven: Some Highways of Albania and a Forgotten Riviera, *Geogr. Rev.*, April, 1921.

FIG. 25—Tirana. Bridge over the Lyane and an old cypress grove.

The most important line of traffic in ancient times was the transversal road, the Via Egnatia. From two starting points on the coast, Durazzo and Apollonia, it led up the Shkumbi valley across country to the lake of Okhrida and into Macedonia. During the war a light railway was erected directly on its foundations from Durazzo to Elbasan; and, thanks to the permanency of much of its construction, this line may be of lasting value. Some sections of the southern branch of the Via Egnatia were also used in the construction of a light railway.

A longitudinal line of traffic, evidently much in use in ancient times when more lively relations were maintained with the south but now without importance, runs from Elbasan to the south through Berat and the eastern Malakastra into Epirus. To the south of Berat the Roman track is clearly visible throughout the eastern Malakastra. The road was partly restored under Turkish rule. During the war it was used by the Austrian forces and as far as about 25 kilometers south of Berat was widened to permit the passage of heavy motor traffic.

Another important longitudinal route runs as a continuation of the southern branch of the Via Egnatia from Fyeri across the westernmost spur of the Malakastra on the one hand and on the other from Durazzo towards the north.

Before the war the only road passable for motor traffic was that between Tirana and Durazzo. From this an important branch road goes northward to Alessio and Scutari, probably following in large part a Roman road. During the war this line of communication was also provided with a light railway.

Passes, Mule Tracks

The routes considered above pass through the plains and by way of the larger valleys. There also exist important caravan roads making use of the mountain passes and only accessible for pack animals. Such are the roads from Tirana to Elbasan across the Krabe pass (640 meters), from Tirana to Kavaya, which makes use in part of the Arzen valley, and another crossing the Malakastra from east to west and utilizing the pass of Sinya (720 meters). In many places these paths show remnants of an old pavement, a type of "Turkish paved way" common elsewhere. It is rough and irregular and of little use except in the rainy season. The paved ways radiate in large numbers from the towns usually to pass shortly into the primitive paths which in the mountainous region follow the ridges as a rule.

Before the war even the most important routes were insufficiently provided with bridges. The Semeni was not bridged at all, the Shkumbi only at Elbasan. There were high-arched stone bridges of Turkish style across the Ossum at Berat and near the confluence of the Ossum and the Devoli at Banya. During the war a modern bridge 600 meters long was built across the lower Shkumbi near Rogojina (on the light railway from Durazzo-Kavaya to Fyeri), and two bridges across the Semeni, the one at Fyeri, the

other taking advantage of a Roman groundwork at Kuchi on the light railway to Berat.

This conspicuous poverty of communications in Lower Albania is to be attributed not only to the low standard of culture but also in considerable measure to the nature of the country. On the one hand there is a lack of suitable stone for building and road construction; on the other hand the climatic conditions are unfavorable.

Inner Albania

The Inner Albanian section of central Albania is predominatingly composed of Mesozoic and Paleogene strata involved in complicated folds and piled up in great overthrust masses. The mountain chains belong to the Dinaric system, which, as a southern branch of the huge Alpine system, stretches as a backbone through the western part of the Balkan Peninsula.

The Mesozoic is distinguished by the wide distribution of basic igneous rocks more or less metamorphosed into serpentine and closely associated with sedimentary material rich in shales, limestones, and flints, including pure flint beds (jasper slates)—a combination common to the whole of the inner Dinaric folds from Bosnia to Greece. The barren soil and the peculiar ferruginous color to which this formation (Upper Jurassic and Lower Cretaceous) weathers give a distinctive stamp to the Inner Albanian scenery.

The Upper Cretaceous lies unconformably over the serpentine formation mentioned above (in the region I investigated as an overthrust mass) in great massives of light-colored limestone that by their contrast with the dark, intimately crumpled and crushed rocks of the serpentine add another characteristic element to the scenery.

The flysch formation in Inner Albania is confined to the western marginal zone of the mountains where it is overlain by a great overthrust mass of the serpentine formation. This tectonic line is well marked by the appearance of bright cliffs where fragments of bulky white limestones have been squeezed in along the thrust plane.

On the extreme western border of Inner Albania is an anticline of nummulitic limestone. Like the limestone of the eastern Malakastra it is a transition formation between Cretaceous and Eocene. In the extreme east the uppermost part of the Shkumbi occupies a rift valley running north to south and containing Neogene deposits. It is the first symptom of the disturbance which finds its most characteristic expression in the sinking that produced the Dessaretic lakes. The soft forms of the Neogene basin contrast sharply with the border of strongly modeled mountain relief.

Morphology

The geological units of this complicated structure of Inner Albania determine the morphological units—outer marginal chain, zone of flysch, serpentine formation, limestone plateaus, Neogene basin. Morphologically Inner

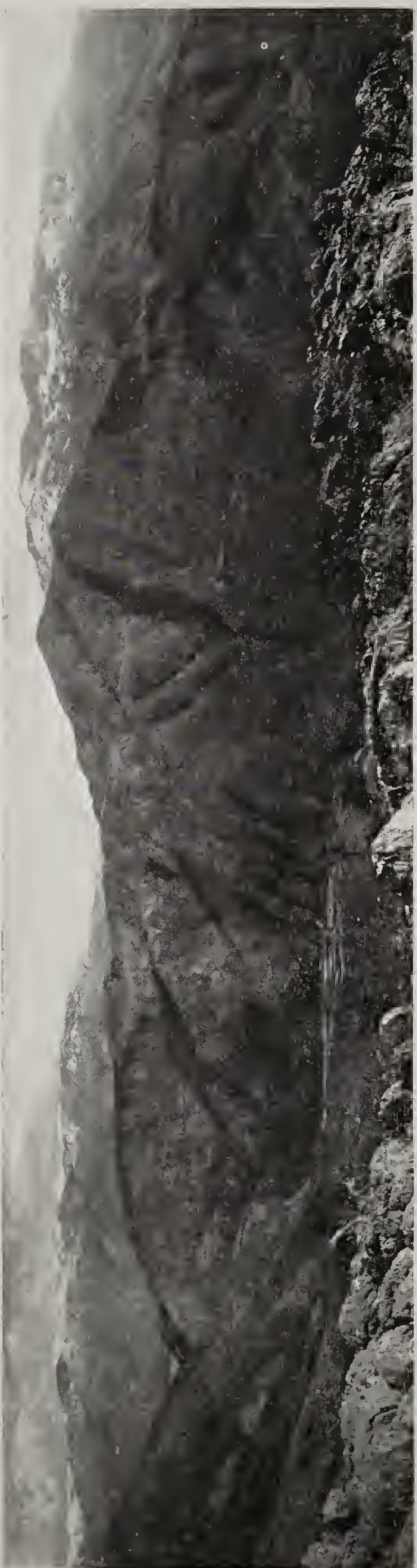

FIG. 26—The region of the middle Shkumbi in Inner Albania. The Shkumbi valley in the left foreground; in the middle ground the typically mature slopes of the serpentine formation (*Serpentin-Schiefer-Hornstein-Formation*) show distinct remnants of earlier river levels, the uppermost (Pliocene) being especially well marked; in the right background the snow-covered Polisit plateau (limestone); in the left background the Yablanitsa Mountains, the border of Macedonia. There are beech forests on the Polisit plateau; the serpentine rocks support only a poor vegetation. The line across the middle heights is the track of the only transverse road in Inner Albania (from Durazzo to Lake Okhrida).

Albania is in a mature stage of development. The mountain forms are strongly modeled, the forms well articulated except only on the limestone masses.

The character of the valleys, however, contrasts strikingly with the mature mountains. The three largest rivers of the country—Drin, Shkumbi, and Devoli—flow through Inner Albania in narrow, steep-walled, often ravine-like, valleys. I myself only followed the course of the Shkumbi. It is true that the narrowest ravine-like sections occur where the river breaks through limestone masses, but the character of the valley as a whole, as well as of most of its tributaries, does not correspond to the mature stage of the mountains but must be described as youthful. On the western margins it approaches maturity; it is most youthful in the central portion where the river has nowhere developed a flat. There is no doubt that Inner Albania has entered on a new cycle, that erosion has been rejuvenated by uplift and warping, strongest in the central part of the region. Evidences of this first cycle are seen in the remnants of valley flats preserved at relative elevations of 150 to 200 meters. In the central area, however, where the most intensive erosion is now in progress, remnants of the old valley floor are found at an elevation of 250 meters.

Evidences of Uplift in the "Wall" of Kruya

Where the outer marginal chain of Inner Albania overlooks the escarpments of Tirana I made an important observation. Here, at an elevation of over 1,000 meters above the sea and at the top of a wall-like precipice, the so-called "wall" of Kruya, is a clearly defined shelf covered with small sink holes. Traces of Neogene beach breccia reveal it as the remains of a platform worn by marine erosion. Since the shelf was formed, as I have said, in the Upper Miocene, Inner Albania has risen more than 1,000 meters during which time folding was going on in the Neogene strata of Lower Albania; that is concomitantly an epirogenic movement in the old land, an orogenic movement in the new land.

Fig. 27—The Miocene platform on the slope of Mali Daytit. Compare with Figure 7.

Wherever limestones occur over considerable areas, as in the Polisit Mountains south of the Shkumbi, a karst landscape is developed which also bears features of maturity. The interfluves are small, appearing riblike between large coalesced sink holes.

The highest mountains of Inner Albania, reaching over 2,000 meters, exhibit traces of diluvial glaciation. From afar I could recognize such typical forms as cirques and U-shaped valleys, with morainic lakes and lakes in cirques—features that are apparent on the new map (replacing the old Austrian staff map, 1:200,000). Almagià has recently given a brief notice on glaciation in the mountains of central Albania in a more extended discussion of the better-known glaciation of the northern part of the country.[8]

[8] Trace glaciali nelle montagne dell' Albania, *Riv. Geogr. Italiana*, Vol. 25, 1918, pp. 85–95.

The Vegetation of Inner Albania

Owing to the much greater absolute height and to the absence of immediate oceanic influence the vegetation of Inner Albania is essentially different from that of Lower Albania and the Malakastra. The subtropical forms retreat, and in their stead appears the forest vegetation of central Europe and, in the high mountains, arctic forms as well. In general the vegetation is poor, and large areas are desertic.

At heights between 1,600 and 1,900 meters I found compact timber forest composed of magnificent beeches. Pine forests ascend to far greater elevations. I did not become acquainted with them; but, according to Baldacci, pine forest consisting chiefly of *Pinus mughus* extends up the high slopes of Tomor (2,300 meters) to a little below the summit. Above 1,900 meters alpine forms, of which Baldacci has given an account, come to the fore.[9]

Below 1600 meters bushwood of oaks and beeches is again the dominant vegetation. It is sparse for the most part and everywhere passes into a shrubby growth which scantily clothes the rocky soil. Especially is this the case on the dry soil of the serpentine formation, highly siliceous and correspondingly poor of plant nutriment. The flysch also forms long stretches of desert, as is the case in Lower Albania.

Maquis is found only at the outer margin of the mountains, as in the region to the east of Elbasan, where it reaches an elevation of 600 meters and more. Farther in the interior the only evergreen shrub that I found in quantity was box, which grows along the brooks and on the lower slopes of the serpentine outcrops.

Grasslands and pasture grounds are unimportant in the inner mountains of central Albania. In this respect a contrast is presented with northern Albania where there are large extents of alpine pastures.

Cultivation is limited to scattered patches of small maize fields in favorable situations such as the flat parts of the slopes and the bottoms of the first cycle of erosion.

People, Settlements, and Traffic

My acquaintance with the people of Inner Albania was limited, and I shall therefore speak of them with reserve. Furthermore, my contact with them was in the region of the Shkumbi, the most accessible part of Inner Albania and the scene of a lively traffic during the war. Generally speaking, the people of Inner Albania as a whole are in bad repute as the wildest inhabitants of the peninsula and the most remote from the ordinary standards of European culture. They live scattered in tribes between which the blood feud is waged not infrequently. The popular accounts of the savageness of the people and of murders that form almost a part of the day's rou-

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[9] Antonio Baldacci: Die pflanzengeographische Karte von Mittel-Albanien und Epirus, *Petermanns Mitt.*, Vol. 43, 1897, pp. 163–170 and 179–183.

tine are in general exaggerations. A more correct appraisal of conditions in the interior of northern Albania has been given by sober observers well acquainted with the country, as for instance Baron Nopcsa, who has stressed the fine hospitality and other generous traits of the mountain people.

The chief business of the population of Inner Albania is sheep breeding. As far as soil conditions permit agriculture is carried on to supply the needs of the individual households, and mention should be made of a careful system of irrigation kept at great pains in a state of good repair. Irrigation ditches run for many kilometers along steep mountain slopes.

FIG. 28—The town of Kruya on the western border of Inner Albania.

The form of settlement, at least in the region I visited, is everywhere that of the widely scattered mountain village. The house type is the *kula*. In some few villages I observed houses better built and carefully whitewashed.

The town settlements of Inner Albania are found only on its extreme borders. Kruya is situated amid splendid scenery on the western precipice of the last chain of Inner Albania at an elevation of above 600 meters. Its pleasant, conspicuously white houses are for the most part surrounded by gardens, and the town presents many picturesque ruins from the times of Skanderbeg. Kruya is probably the most salubrious town of Albania and in the hot months of summer is a favorite resort of the rich.

The traffic of Inner Albania is confined almost exclusively to mule tracks. The only road at all passable for wheeled traffic is the Via Egnatia, already mentioned, which here uses for the most part the Shkumbi valley. It played

an important part in the late war, first as the line of Serbian retreat and second as a supply line for the Austrian forces. But it does not satisfy modern demands: the middle part, nearly 20 kilometers in length, which avoids the gorge of the Shkumbi is entirely unfinished. One quite frequently comes across remnants of roads begun by the Turkish government but never completed and useless even for local traffic, for the muleteers prefer shorter and more direct routes.

Notes on the Climate of Albania

Up till now very little data have been available as to the Albanian climate. Meteorological observations carried over any length of time were known only from Scutari. For the rest dependence was on isolated observations published by travelers. During the war systematic observations in numerous observatories were made by the Austrian meteorological service. Much valuable material was collected during a period of more than a year and a half. A part of this hitherto unpublished material has been put at my disposal by Dr. Maurer, the leader of the field meteorological service in Albania, and will be quoted here with some of my own observations.

Albania lies in the zone of subtropical climate and is throughout influenced by oceanic conditions, as it is open to the prevailing western sea winds. The chief characteristic of the climate is determined by the seasonal distribution of rainfall. There is a distinct period of autumn rainfall (mostly from the middle of October to January) and a period of summer drought (from June to September). The great intensity of the autumnal rains is a factor whose influence should not be underrated in considering in detail the evolution of the Albanian scenery. The origin of the "badlands" forms in the flysch is considerably favored by these powerful rains, and the gulleying and the landslides, especially characteristic of the Malakastra, are an immediate consequence of them. Military experience in the western Malakastra has shown how extraordinarily the conditions of the landscape can change in the course of a single season. With the coming of spring such change, for instance, necessitated a transference of the bulk of the communications as well as the trenches. These conditions partly explain the lack of beaten paths in the hill country of Lower Albania and the Malakastra, the climatic factor in conjunction with the unconsolidated nature of the rocks rendering it very difficult to keep the roads in good state. The mode of seasonal rainfall distribution is illustrated in Table I, averaging observations for the years 1917 and 1918 at Berat and Tirana.

The table shows that spring also is marked by numerous days of rainfall, but the amount is not considerable; the spring rains almost always have the character of sudden showers and are often associated with thunderstorms.

Kruya, lying on the western slope of the Inner Albanian mountain region, shows a still more extreme rainfall régime. Here in October a monthly total of 218.9 millimeters was recorded, with a maximum of 40.2 millimeters on October 11; in January a total of 113.5 millimeters, with a maximum of

41.9; in February a total of 117.4 millimeters, with a maximum of 40.6; and in March a total of 125.3 millimeters. The rainy period here lasts throughout the winter in almost undiminished force till spring, obviously because the mountain barrier intercepts all the rainy squalls brought by the western and southern winds.

Of temperatures, only some extremes may be given. In Lower Albania temperatures below zero are rare in general, and the winter of 1917–1918 must be described as abnormally severe. Tirana showed five frosty days in

TABLE I—RAINFALL AT BERAT AND TIRANA, 1917 AND 1918
(In millimeters)

Months	Total Rainfall	Maximum on any Day	Days with Rainfall	Remarks
June . . .	27.8	18.7	6	
July . . .	0.5	0.3	2	
Aug. . . .	17.3	17.3	1	1 thunderstorm
Sept. . . .	4.9	4.6	3	3 thunderstorms
Oct. . . .	122.9	27.1	15	10 thunderstorms
Nov. . . .	108.0	31.9	13	3 thunderstorms
Dec. . . .	123.1	33.6	17	2 thunderstorms
Jan. . . .	64.3	24.7	10	1 day with snow
Feb. . .	53.4	25.2	8	3 thunderstorms
March . .	66.5	23.0	13	4 thunderstorms
April . . .	73.3	19.7	16	7 thunderstorms

December and a minimum temperature of $-1.3°$ C.; January had seven frosty days and a minimum of $-5.3°$ C.; February, three frosty days and a minimum of $-1.3°$ C. The mean temperature of each of the three winter months was somewhat above $7°$ C. The winter of Berat with the minimum of $-4°$ C. and with six frosty days in January appeared little milder. Kruya, on the contrary, owing to its considerably greater height, has a more severe winter: here in December a minimum of $-5°$ C. was registered, and on two days the temperature did not rise above zero. Here, too, January shows the lowest temperature, with a minimum of $-6.8°$ C.

As has been stated, these data do not give a correct idea of a normal Albanian winter; they are those of an extremely severe one and are of interest to that extent.

The highest temperatures are probably reached in the months of July and August. Thus I have before me observations from Elbasan, which,

owing to its situation in an enclosed basin, is considered the hottest town of the country.

In July, 1917, the mean was 25.86° C. and the maximum 36.8° C.; in August of the same year the mean was 26.75° C., the maximum 39.8° C. This last temperature is an extreme probably seldom reached; altogether the summer of 1917 was considered very hot. In July, 1918, in the Shkumbi valley below Elbasan I measured about noon a maximum of 36.2° C. with a sling thermometer; and on several days running, 32° C.–34° C. This probably corresponds to the highest temperatures reached in summer. The great heat of summer is sultry and burdensome only in the more enclosed valleys and the plains of the interior, in the hill country and on the shore it is moderated by the cool sea breeze of the daytime.

The summer heat of Inner Albania is much more moderate. Kruya in the hot summer of 1917 only showed a maximum of 33.6° C. in August, with a mean in this month of 23.3° C. In August, 1918, which I passed for the most part in the Inner Albanian region of the Shkumbi, I did not feel the heat of summer disagreeable, in spite of the considerable effect of radiation in this region poor in vegetation, as the cooling influence of the sea breezes reaches even up to that point.

THE CULTURAL TRANSFORMATION OF THE COPPER ESKIMO *

By DIAMOND JENNESS
Victoria Memorial Museum, Ottawa

It is rare enough today that the student of human culture can light upon a people who still cling to their primitive mode of life in utter ignorance of the outside world: more rare still that he can watch the tide of civilization slowly reach their shores and finally engulf them in its stream. Usually, long before the ethnologist approaches such a country, the products of civilization, handed on from tribe to tribe, have already preceded him and the ancient manner of life no longer exists. Thus, here in America, the horse came in only with Columbus; yet before the white man reached the plains the Indians throughout the basins of the Saskatchewan, Missouri, and Mississippi had been transformed to roving horsemen. However, in one small section of the continent, in the region of Coronation Gulf just a thousand miles north of Winnipeg, there remained, down to the twentieth century, some groups of Eskimos who had no contact with the outside world, to whom the arts and products of our civilization were unknown and the very name of white man was only a legend. Suddenly and without warning, their isolation has been rudely shattered, their independence destroyed, their culture transformed, and they themselves, like their kinsmen in Alaska and Labrador, are being reduced to the level of economic slaves in the service of European civilization.[1]

EARLIEST VISITS TO CORONATION GULF

The first white man to sight the waters of Coronation Gulf was Samuel Hearne, who traveled overland to the mouth of the Coppermine River in 1771 with a party of Chipewyan Indians. Just below Bloody Fall they encountered a few families of Eskimos peacefully engaged in fishing, all of whom they massacred. After this the Indians were afraid to linger in the country, and, with Hearne, hastily retreated to the south.

The next explorer to visit the region was Captain (afterwards Sir) John Franklin. Starting from Fort Enterprise on his first journey in 1821 he reached the lower waters of the Coppermine in a few weeks. He too found some Eskimos fishing below Bloody Fall; but, unlike Hearne's party, he tried to establish friendly relations with them. Most of the natives fled, but Franklin succeeded in communicating with one family from whom he

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* Published by permission of the Director of the Victoria Memorial Museum, Ottawa, Canada.

[1] See the author's articles "The Copper Eskimos," *Geogr. Rev.*, Vol. 4, 1917, pp. 81–91; and "The Eskimos of Northern Alaska: A Study in the Effect of Civilization," *Geogr. Rev.*, Vol. 5, 1918, pp. 89–101.

obtained a little information about their habits. He then continued his journey, following the coast line eastward as far as Cape Turnagain on Kent Peninsula. He saw fresh tracks of the natives in many places but not the natives themselves. On his return he ascended the Hood River for some distance, then abandoned his canoes, and struck overland to Old Fort Providence on Great Slave Lake. No white man since Franklin's day has ever traversed this route, although the Eskimos not infrequently make the journey in the course of a summer's hunting.

Finding of the Copper Eskimos

On Franklin's second expedition to the Arctic, in 1826, two of his lieutenants, Richardson and Kendall, sailed from the mouth of the Mackenzie to the mouth of the Coppermine, mapping the whole of the coast line. No Eskimos were seen on this journey, although a party was found to have just quitted Bloody Fall, probably frightened by the presence of the white men. Dease and Simpson met with no better fortune in 1838 when they traversed the coast from the mouth of the Coppermine to Kent Peninsula. In the following year, however, these two explorers discovered a camp of about thirty natives a few miles west of the mouth of the Coppermine. Most of them fled to the hills, but the family that remained behind was very favorably impressed by the white men, and the friendly relations that were then established proved of great service to Richardson ten years later. From the Coppermine Dease and Simpson turned eastward and followed the mainland to beyond Backs River; then, returning, they explored a part of the south coast of Victoria Island. No more natives were seen throughout their voyage, although vestiges of them were noticed in many places.

Friendly Relations Established

In 1848 Richardson repeated his voyage of twenty years earlier from the mouth of the Mackenzie to the Coppermine River. His boats were frozen in near Cape Kendall, about thirty miles from the mouth of the Coppermine, and the party had to proceed to Great Bear Lake on foot. Fortunately the Eskimos whom Dease and Simpson had met ten years before were encamped on the Rae River, and readily consented to ferry the explorers across in their kayaks. During the next two years Richardson's companion, Rae, revisited the region and explored not only the mainland eastward to Cape Alexander, but all the southern coast of Victoria Island from Cape Back to Pelly Point. Besides meeting his old acquaintances on the Rae River he had an interview with three Eskimos near Cape Flinders on Kent Peninsula; and in the southwestern corner of Victoria Island, near Cape Hamilton, he visited a settlement of thirteen families. Rae was much impressed by the respect with which the Eskimos treated his caches; they had visited some which he left on the coast but had not touched the contents.

McClure was the next navigator to fall in with the Copper Eskimos, early

in 1851. His ship was wintering in Prince of Wales Strait, between Victoria Island and Banks Island, and a sledge party met some natives at the southern entrance of the strait. Collinson, his fellow explorer, spent the following winter, 1851–1852, in Walker Bay on the western coast of Victoria Island, and about fifty Eskimos built their snow huts beside his ship. As soon as the ice broke up in the summer he sailed eastward through Coronation Gulf and established a winter base in Cambridge Bay. Rae had seen many Eskimo caches in this place two years before, but Collinson met

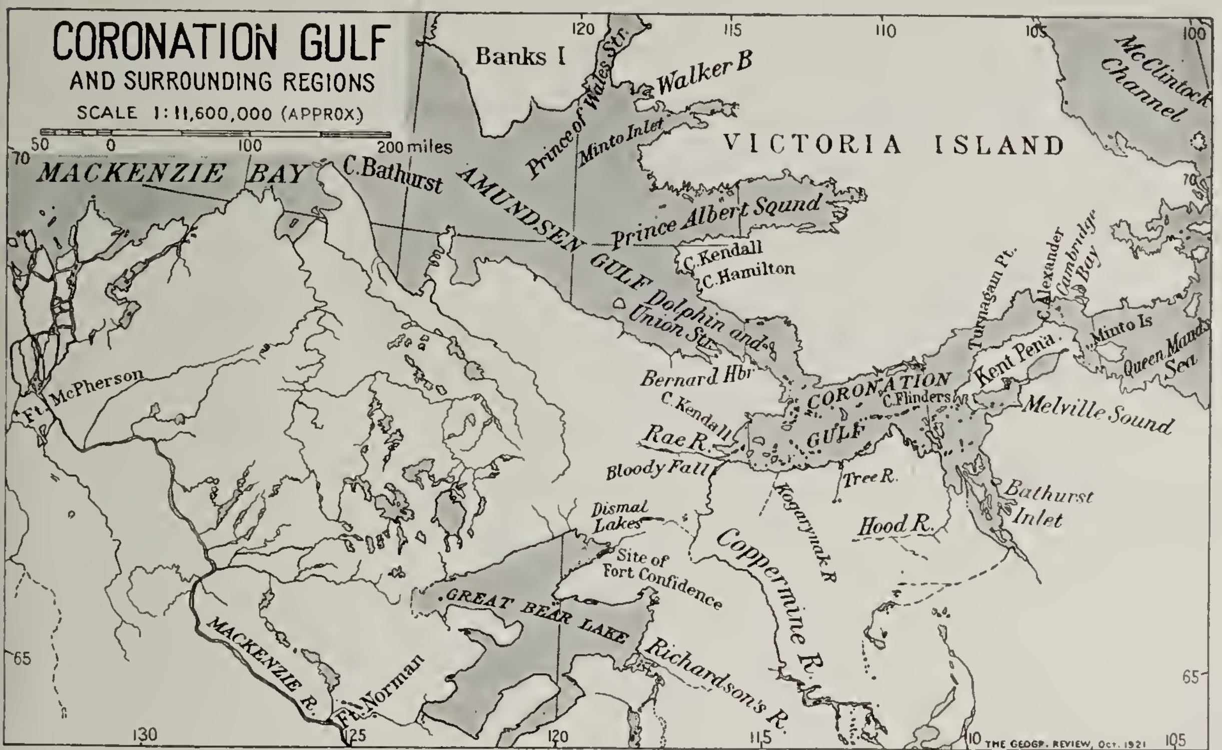

FIG. 1—Sketch map of the Coronation Gulf region, the country of the Copper Eskimos.

the natives themselves. Between two and three hundred of them spent the winter in the vicinity of his ship, which they visited at intervals for several months.

Hanbury's Journey

This voyage of Collinson marks the end of the first period of exploration. Beginning with Franklin's search for a Northwest Passage, exploration had been continued by searchers for Franklin himself; and, when the discoveries of McClintock and Rae had cleared up all doubt as to his fate and established the existence but extreme difficulty of a Northwest Passage, interest in Arctic exploration waned. For fifty years Coronation Gulf remained unvisited; then, in 1902, the traveler-sportsman David Hanbury made a journey from Hudson Bay north to the Arctic coast and west to the mouth of the Coppermine, which he ascended to Great Bear Lake and the Mackenzie River. On this remarkable journey Hanbury encountered many small bands of Eskimos, of whom, as well as of the country through which he passed, he has left a detailed and valuable account.

Visits of Stefansson and Bernard

Three years after Hanbury's journey a Danish trapper and trader, Captain Klengenberg, driven by the competition of rival traders in northern Alaska and the Mackenzie to seek new fields to the eastward, wintered with his small schooner, the *Olga*, in the vicinity of Cape Kendall on the southeastern corner of Victoria Island. A party of Eskimos visited his ship for three days and then disappeared to the north again. Two years afterwards, 1907–1908, an American whaler, Captain Mogg, wintered in Minto Inlet and met some of the Eskimos there. It was the strange reports that these two adventurers carried west with them again that induced Vilhjalmur Stefansson to re-explore this forgotten region; and in 1910, traveling by sled along the coast, he visited the Eskimos of Dolphin and Union Strait and western Coronation Gulf, then, like most of the earlier explorers, ascended the Coppermine River to Great Bear Lake. Accompanied by Dr. R. M. Anderson, he returned in the following year and visited also the natives of Prince Albert Sound. In this same year, 1911, one of the great modern pioneers of the Arctic, Captain Joseph Bernard, sailed into Coronation Gulf with his schooner, the *Teddy Bear*, and remained for three years in the Copper Eskimo country. His first winter, 1910–1911, was spent at the Kogaryuak River a few miles east of the Coppermine; his second, 1912–1913, in Bernard Harbor, in Dolphin and Union Strait; and the last, 1913–1914, in a little bight behind Cape Kendall on Victoria Island.

Later Contacts

Up to this period the Copper Eskimos, from fear of the Indians, had avoided the shores of Great Bear Lake, or had skirted only its northeastern extremity. But from 1908 to 1911 two Englishmen, C. D. Melvill and John Hornby, settled on the lake, and the Eskimos began to visit them for trade. Melvill returned south in 1911, but Hornby remained for three years longer. In 1911 Father Rouvier established a mission to the Eskimos near the Dismal Lakes, where Father Le Roux joined him in 1912. In 1912 also two brothers, G. M. and L. D. Douglas, accompanied by the geologist Dr. Sandberg, fell in with a number of Eskimos during the course of an investigation into the copper deposits of the Coppermine valley; and two other white men, Harry Radford and George Street, traveled overland from Hudson Bay to Bathurst Inlet, where a misunderstanding arose with the natives, and the two were murdered. The same fate befell Father Rouvier and Father Le Roux in the following year, when they followed the Eskimos to the mouth of the Coppermine River. In 1914 Mr. D'Arcy Arden, a well-known traveler in the north, established himself at Great Bear Lake to trade with the Indians and Eskimos and visited the mouth of the Coppermine two years later with a patrol of the Royal North West Mounted Police.[2] In 1914, the

[2] See Reports of the Royal North West Mounted Police; also C. D. La Nauze: A Police Patrol in the North West Territories of Canada, *Geogr. Journ.*, Vol. 51, 1918, pp. 316–323.

Canadian Arctic Expedition arrived in the country, the southern party making its headquarters at Bernard Harbor in Dolphin and Union Strait, and the northern party at Cape Kellett on Banks Island.

Canadian Arctic Expedition

The entrance of the Canadian Arctic Expedition was the signal for a regular tide of immigration. Its southern party left the country in 1916. In the spring of that year the Royal North West Mounted Police sent in a patrol to arrest the murderers of the two priests. In 1917 another patrol went in from Hudson Bay, and in 1919 a police post was established at Tree River in Coronation Gulf. In 1916 Bernard Harbor, abandoned a month before by the Canadian Arctic Expedition, was occupied by an Anglican mission and the Hudson's Bay Company; while Captain Klengenberg, who had wintered twelve years before on Victoria Island, settled at the mouth of the Coppermine River, and Captain J. Bernard, returning from the west, made the Kogaryuak River his winter quarters again. Farther to the north, at Minto Inlet on Victoria Island, a party of adventurers from Alaska spent the winter, but their leader Wittenberg was arrested at Herschel Island in the summer of 1917 and sentenced to six months' imprisonment for falsification of customs papers. In 1917 Captain Bernard sailed east to Taylor Island, where he spent the next two winters traveling among the natives around the little-known Queen Maud's Sea; he returned to the Kogaryuak River in 1919 and in 1920 sailed back to Alaska. Meanwhile the Hudson's Bay Company was strengthening its hold on the country by establishing two more trading posts, one near Tree River in 1919, the other in Melville Sound behind Kent Peninsula in the same year. Its rival, the Northern Trading Company, was expected to establish a post at Tree River this last winter, 1920–1921. In addition to these, the Roman Catholic Church in 1918 reopened its mission near the Dismal Lakes for the instruction of those Eskimos who wander up the Coppermine River during the summer.

Relation with the Eskimos to the West

Such, in brief outline, is the history of the exploration of the Coronation Gulf country. A few words are necessary about its connection with the Eskimo regions to the west. Less than a century ago there had been frequent intercourse between the Copper Eskimos and their western kinsmen around Cape Bathurst, but this was broken off as soon as trading posts were established in the delta of the Mackenzie River. During the last few years, however, the western natives, more or less civilized from a century's contact with white men, have been renewing their old connection with the Copper Eskimos. Some have gone in as servants and interpreters to the traders and missionaries and married the women of the country. Several Copper Eskimos, on the other hand, have been taken west to Herschel Island and have spent a year or two with the Mackenzie Eskimos before returning home.

Thus a double pressure has been brought to bear on the Coronation Gulf natives, and their culture is fast breaking down under the strain of the new conditions. Let us briefly recall the old culture.

Old Culture of the Copper Eskimos

The geographical center of the Copper Eskimos' country may be taken as Coronation Gulf, but they extend from Dolphin and Union Strait and Prince Albert Sound in the west to Kent Peninsula and Albert Edward Bay in the east. In 1916 their total number was roughly estimated at between 700 and 800, scattered in groups of from 20 to 100 in different districts. For food these Eskimos depended on seals in winter, caribou and fish in summer; hence while they were able to concentrate in settlements on the sea ice from November to April, the rest of the year they were dispersed into small bands of from two to eight persons in order to scour the land for the scattered herds of caribou. Wood is extremely scarce throughout this region except inland in the valleys of the Coppermine and Tree Rivers, and so wooden dwellings such as are used by the natives to the west were unknown; the Copper Eskimos lived in snow huts throughout the winter months, and moved into tents of caribou skin in the warm days of spring. For clothing they wore caribou-skin coats shaped very much like a European dress coat, short in front and with a long swallow-tail behind; a hood, attached at the back, pulled over the head like a cap; they had short caribou-skin breeches reaching just below the knees, and caribou-skin stockings that extended up under them. Over the stockings they wore in winter white sealskin shoes that fastened around the ankles, but in summer they had waterproof boots of the same material that fastened below the knees. The women's dress was much the same as the men's, the main differences being that in the coat the hood and back and shoulders were enlarged to carry the baby, while the socks and waterproof boots, instead of fitting tightly around the legs, were broad and open and fastened by a long tapering strap into the belt.

Even as late as 1914 the Copper Eskimos were still in what might be called the stone age. Hanbury twelve years earlier had found practically no iron at all in use. For hunting caribou the bow and arrow were universally employed, while for seals there was a harpoon fitted with a copper point. Fish nets were unknown; salmon, trout, and tomcod being either caught with copper hooks at the end of a long line or trapped in stone weirs and speared with tridents having barbs of either copper or antler. No pottery was made; instead, the Eskimos carved rectangular cooking vessels out of soft soapstone. Heather or dry willow twigs were the usual fuels in summer, but in winter seal oil was burned in shallow soapstone lamps by means of long wicks of cotton grass seed. The only means of transportation were the sled in winter and packing on the back in summer; the kayak was employed for hunting only, while the larger Eskimo skin boat, the umiak, had dropped out of use altogether.

The social and domestic life of the Copper Eskimos was equally primitive. There were no chiefs or persons in authority, even the shamans having no influence beyond that inspired by their personalities and character. Food was shared among all the members of the community, but all other property was held individually. Marriage took place at an early age but had little permanence until a child was born, when the couple usually settled down for life. Polygamy was rare owing to the preponderance of males over females and the difficulty of supporting more than one wife; while polyandry, though not unknown, was discountenanced because it invariably led to quarrels and even murder. The health of the natives was exceedingly good, the only conspicuous ailments apparently being simple colds, which affected them transiently each autumn when they moved from tents into the more tightly-sealed snow huts, and some derangement of the stomach that may have been ptomaine poisoning. The average longevity seems to have been about sixty years, and the women were as fertile perhaps as other races; but the natural increase due to the birth rate was overbalanced by the extraordinary frequency of infanticide. This, together with the frequency of murder and the prevalence of the blood feud, constituted the most serious blot on the social life of these Eskimos.

Striking Change in Material Culture

Such, in brief, was the culture of the Copper Eskimos at the time of their discovery. It persisted almost unchanged down to 1914 when the Canadian Arctic Expedition entered the country. Iron, it is true, had become more abundant, but copper was still freely used for everything except knives and harpoon points. Five rifles had been introduced during the three preceding years; but their owners had exhausted all their ammunition, and every hunter still depended on his bow and arrows to procure him food and clothing and shelter during the summer months. Since 1916, however, the revolution has been rapid and complete. At the present day there is hardly a bow in the country, almost every hunter possessing a high-powered rifle. Copper is no longer used except for rivets and for the manufacture of spurious antiques. The cooking vessels of stone have yielded to iron pots and caldrons, which are both lighter to carry and less fragile; but the stone lamps still hold their ground, since no other material is so suited to the burning of blubber fuel. Cloth tents are slowly but surely replacing the tents of seal and caribou skin; occasionally a sheet-iron stove is found inside them, despite the dearth of firewood. Even the native style of dress is changing; instead of the long frock coat, the Copper Eskimos are adopting the less picturesque garment of the western natives, which is cut straight round the bottom and reaches to the thighs. It is perhaps a more rational garment on the whole, as it affords better protection to the front of the body; but the long tight-fitting trousers reaching to the ankles that many of the men are beginning to wear, copying the western model, are certainly less healthful

than the old-fashioned breeches that protected the limbs without restricting the circulation of air. Cloth overalls also are common.

Changed Habits of Hunting

It is not only the material culture of the Copper Eskimos that has been revolutionized by the new conditions but their manner of life as well. For the first time in their history they have come into contact with the fur trade, and all their energies are being directed to the trapping of foxes and other fur-bearing animals. Money as yet has little or no value in their eyes, their main requirements being rifles and ammunition, iron tools, and cloth for tents and clothing. In former years their lives had followed a regular cycle of change, November to April being passed on the sea ice in the hunting of seals, and the remainder of the year on the land in hunting caribou and fishing for trout and salmon. Now even this has been altered; for, since fox trapping can be carried on profitably only on land and only during the winter months when the furs of animals are in their prime, there is every inducement for the Eskimos to shorten their stay on the ice and depend on caribou for food instead of seals. In the winter of 1919–1920 only about half the natives around Dease Strait settled on the sea ice to hunt seals. The remainder were hunting caribou and trapping foxes on Kent Peninsula, purchasing the blubber they required for their lamps from the Hudson's Bay Company's agent in Melville Sound, who in turn purchased it from the natives on the ice. Naturally the possession of high-powered rifles has greatly facilitated the possibilities of caribou hunting at all seasons of the year, but the unfortunate feature of the case is that, whereas the seals appear to be almost inexhaustible, the caribou are rapidly diminishing in numbers year by year. According to Captain J. Bernard, caribou were very numerous around the Kogaryuak River in the fall of 1910 and spring of 1911, and many remained in the vicinity throughout the winter; but in the season of 1916–1917 their number was reduced by more than half, and none remained through the winter. In the spring of 1920 he estimated the caribou migrating across Coronation Gulf at about one-tenth the number there had been in 1910. In fact, judging from the intensity with which they are being hunted and the diminution in the herds during the last ten years, he came to the conclusion that in another ten years they will be almost exterminated in this region.

Wider Range of Migration

Not only has there been a change in the mode of life during the last few years, but the range of migration has been extended. Throughout the nineteenth century, while the north and west of Canada were being explored and settled, the region of Coronation Gulf was left in lonely isolation. Five hundred miles of barren coast line separated the Copper Eskimos from their nearest neighbors to the west, and hostile Indians barred the road south-

ward; on the north was an uninhabited archipelago; while to the east, dotted at wide intervals along a coast not very prolific in game, were Eskimos almost equally primitive and therefore seldom encountered. But the establishment of trading posts at Great Bear Lake within the last ten years has beckoned the Eskimos southward. In 1919 one family even reached Fort Norman on the Mackenzie, while others were wandering far inland nearly to the shores of Great Slave Lake. The Indians, dominated by the white man, have ceased to be a barrier; indeed some Tree River Eskimos in the summer of 1916 traveled south to the upper reaches of the Coppermine River for the express purpose of trading with Dog-rib Indians from Fort Rae, and in 1917 a band of seventeen Indians descended to the mouth of the Coppermine to trade, the first time for 150 years they had ventured to approach the Arctic coast. The renewed connection between Coronation Gulf and the Mackenzie Delta I have mentioned already, but even the Hudson Bay region has been brought perceptibly nearer. Three parties of white men have crossed over from Chesterfield Inlet to Coronation Gulf, and there is now frequent intercourse between the Copper Eskimos and the natives inland from Hudson Bay. The barriers that kept the country isolated for so many centuries have at last broken down, and civilization has gathered one more primitive people within its fold.

Social and Religious Changes

But how has the social and religious life of the Copper Eskimos been affected by this new civilization? The adoption of its external trappings, of the white man's clothing and the white man's pipe, can never change a native into a European. Life in the Arctic must always be very different from life elsewhere, if for no other reason than that the population in places so remote as Coronation Gulf must be nomadic, depending largely on hunting and fishing to supply the necessaries of life. There can be no large permanent villages. The fundamental unit of society is the family—the man, his wife, and their children—and a unit of this kind is hardly susceptible of change. No organized system of government had ever been evolved, and the imposition of white control does not favor such an evolution. The arrest of four or five natives has effectively abolished indiscriminate murder and the practice of the blood feud and so increased the security of life; moreover the teachings of the missionaries and the warnings of the police have diminished infanticide to such an extent that the number of babies in the different communities has increased remarkably. But in all other respects social life has undergone little change. The spirit of hospitality still holds sway in every household; and friend and stranger, even the white trader and the white policeman, meet with an equal welcome. In the winter evenings the dance houses still resound with singing and drumming as of old; but mingled with the dance songs are missionary hymns, while shamanistic rites and the cheerless propitiation of imaginary demons are rapidly fading away before the more comforting light of the gospel.

Introduction of the White Man's Diseases

Apart then from the gradual extermination of the caribou we might be tempted to say that civilization has brought nothing but blessings to the Copper Eskimos. Unhappily the case is far otherwise. Wherever the white man goes he carries his own peculiar diseases, and these are the more fatal to native races inasmuch as they have not had time to develop a partial immunity. In 1734 and 1735, 2,000 Greenland Eskimos were carried off by smallpox, and about that time the same plague ravaged the Labrador Eskimos also. Farther west, in the Mackenzie Delta, the population thirty years ago was estimated at 2,000; today it is barely 500. Wherever on the American continent the Eskimos have come into contact with Europeans, there we find pneumonia and tuberculosis and various other diseases. The Coronation Gulf natives alone remained untouched until four short years ago. Since then one native has died of what was diagnosed by a missionary as tuberculosis, another advanced case is reported from the Coppermine River, and the last news that has come out of the country announces the outbreak of typhoid in the fall of 1920. The introduction of other diseases is apparently only a matter of time. Possibly they could be checked by the establishment of some kind of quarantine such as the Danes instituted for Greenland; the experiment, at all events, would be well worth trying.

The Outlook

Looking to the future, what is to be the fate of the Copper Eskimos, supposing they survive, as many of them probably will, the inroad of our diseases? Already they are becoming dependent on the outside world for tools and hunting weapons and camp equipment. A quarter of a century hence, it is safe to say, there will be practically no caribou at all in their country. Then, unless herds of domesticated reindeer are successfully imported and the natives trained to take care of them, either they will be forced to migrate elsewhere or, what is far more likely, they will become absolutely dependent on the outside world for clothing and to some extent also for food. Seals, no doubt, will always be plentiful, and the rivers and lakes will continue to abound with fish; but, as in the case of their kinsmen in Greenland and Alaska, tea and sugar and flour and rice and other cereals will become as necessary to them as meat. Then, instead of a hardy primitive race of hunters living its own independent life, we shall have scattered groups of trappers, enslaved economically to the great world south of them, while at the same time will ensue profound changes in blood and speech through progressive intermingling with the white men.

LOWER CALIFORNIA AND ITS NATURAL RESOURCES: A REVIEW*

By W. M. Davis

The Biological Survey of our Department of Agriculture, which, unlike the Geological Survey of the Interior Department, appears not to be limited to studies of our national domain, found sixteen years ago that it needed first-hand information on the peninsula of Lower California, little known in spite of the many expeditions and the numerous books and articles that had been concerned with it. Hence E. W. Nelson, chief of the Bureau, accompanied by E. A. Goldman, went in March, 1905, to make a thorough examination of that arid region. During a stay of eleven months the two experts covered a distance of over 2,000 miles in the saddle, traversing the 30- to 100-mile breadth of the peninsula eight times in different parts of its 800-mile length.

The Work as a Whole

The report on their work, lately issued after long delay, includes a narrative of the journey, a sketch of physical features, brief notes chiefly physiographic on recent geological history, and descriptions of the principal mountain ranges, plains and larger valleys, streams and water supply, islands, and climate. Then follow summaries of plant life, animal life, subordinate faunal districts, and life zones; these sections include many lists of plants and animals and represent an immense amount of high-grade biological work. A brief statement of natural resources in plant and animal life is added. The volume closes with outlines of previous explorations and an extended bibliography of some 360 reports and essays, both these subjects being brought up to 1919. The general map, compiled from many sources, printed in black outlines and hachures with a red route line, on a scale of 1:2,000,000, and measuring 29 by 22½ inches, is the best representation of the region yet published. The coast alone has been surveyed; the interior topography is sketched.

Scope of the Present Review

A great fund of trustworthy information is thus brought together in excellent form. The narrative of the journey is very readable; the physiographic descriptions are easily understood and give an informing picture of the desert peninsula as a whole; and the biological chapters may be taken as fully authoritative.

* E. W. Nelson: Lower California and Its Natural Resources. 194 pp.; maps, ills., bibliogr., index. *Memoirs Natl. Acad. of Sci.*, Vol. 16, First Memoir, Washington, D. C., 1921. 12 x 9½ inches.

The present notice is concerned chiefly with those pages of the memoir which treat the physiographic features of Lower California, as the accounts of the flora and fauna are presented for the most part in form for botanists and zoölogists and not for geographers. The notice, moreover, is based chiefly on the middle pages of the volume (48–102), in which the leading features, as determined by observations during the long zigzag journey supplemented by the records of other travelers, are well generalized; but some items are taken from the narrative. It may be suggested that readers who, like the present reviewer, examine the memoir chiefly from a geographical point of view, will do well to turn first to the middle of the volume, so that when return is made to the preceding pages the physiographic items there described in narrative style may be understood as parts of the larger forms to which they belong; and it may be added that the narrative could be consulted with much greater ease if its dates were set up in bold-faced type in the text and were also printed on the map in red at appropriate points on the red route line.

The Mountain Ranges: San Pedro Mártir

The numerous mountain ranges of the peninsula are taken to be, as a rule, larger or smaller fault blocks, moderately dissected since their slanting uplift. They nearly all have northwest-southeast trends like the peninsula as a whole, but their sides will be here spoken of as eastern and western. One of the largest ranges is the granitic mass of the Sierra San Pedro Mártir, which with its lower terminal dependencies has a total length of over 100 miles opposite the uppermost part of the Gulf of California. Its crest, gradually rising from either end to a middle stretch 6,000 or 8,000 feet in altitude, is of simple profile, belying the name "Sierra"; its precipitous eastern face, scored by narrow, steep-walled canyons, descends 4,000 to 6,000 feet in about 5 miles from the even crest to a simple base line in an elongated intermont basin, the valley of San Felipe, shut in from the Gulf by subordinate ridges. The western slope of the range makes a relatively gradual descent to the ocean, 40 or 50 miles distant from the crest. The higher part of the western slope is of so moderate a relief that it is described as a "plateau," but in view of its persistent inclination it might be better called a slanting highland. Its surface offers much variety of form, as it is surmounted by knobs and ridges and dissected by narrow valleys. Much of the highland exhibits bare rock, bearing many large boulders presumably weathered in place. The highest summit, La Providencia Peak, over 10,000 feet in altitude, appears to result from the location of one of the surmounting ridges on the range crest, somewhat north of its mid-length; the ragged "cockscomb" of the peak is perhaps due to the local sharpening of the ridge end by the retrogressive erosion of east-face canyon heads on either side of it. A curious characteristic of the highland is the occurrence of occasional flat-floored grassy basins or parks, the origin of which is not explained. In view of the low latitude of their district (31°) and of the aridity of the region,

a glacial origin seems hardly possible, in spite of the considerable altitude of the Sierra. It may be remarked that the steep east-facing escarpment of this granitic range and its simple eastern base line confirm very clearly its origin by up-faulting; and the long westward slope of its slanting highland may be taken, apart from its recently incised valleys, to represent the general character of the region before block faulting took place. This part of the peninsula must then have been a granitic lowland of moderate relief, interrupted here and there by rounded ridges and knobs and overstrewn with weathered boulders; and as a lowland it must have had less rainfall than it now enjoys since gaining its highland estate.

Sierra Juárez

The Sierra Juárez (p. 55), farther north, is another granitic range of pronouncedly unsymmetrical form, strongly scarped on the east and sloping moderately to the west, and again possessing ridges and knobs, bare rock and boulders, parks and ponds on the upper part of its slanting highland. It begins near the international border and trends almost due south for 80 miles, so as to overlap on the east the curve made by the scarp of the San Pedro Mártir range toward its northern termination; and the Sierra Juárez has a curved southeastward extension in the Sierra San Felipe and other smaller ranges, which lie to the east of the San Pedro Mártir along the Gulf coast. Block faulting with tilting to the west thus seems to be responsible for the main features of these and of many other ranges; but, if the region is ever studied in detail, it will probably be found that the large single blocks here instanced are more or less shattered where they approach each other.

The Southern Ranges

The mountains in the southern half of the peninsula—except the terminal Sierra de la Victoria, which appears to be an east-tilted granitic block—form a nearly continuous mass 300 miles in length and 30 to 50 in width, and are described as consisting of sandstones covered by lava beds, much dissected; here a fault-block origin of the ranges is not specified. The attitude of the sandstone strata and of the lava beds is seldom if at all mentioned in the text, although a nearly horizontal attitude for the latter seems to be implied by describing their surface as making plateaus and mesas; and this is confirmed by the forms of canyon walls shown in several plates. Nevertheless, it may be inferred that the lava beds have a gentle inclination to the west, as if their eruption had been previous to the block faulting of the region. Thus a "lava-covered plateau . . . cut in all directions by deep ragged box canyons" is described as forming the "Pacific slope" of one of the largest ranges next south of the peninsula mid-length; and the lava-bed cliffs of the canyon walls are said to decrease in height down stream. Again, it is said that in a district farther south, "canyons of varying depths gash the

surface of this great volcanic plain, which gradually rises [eastward] to its greatest elevation" near the range crest (p. 38). More explicit still is the account of the southern end of the southernmost lava-covered range, the Sierra de la Giganta. Its western base is a "rolling country," which increases in relief as the long ascent of the range is begun until sharp-edged mesas show that they as well as the lower rolling country "were made by the erosion of a great plateau sloping down" from the high range crest. The deep canyons within the range exhibit the underlying sandstones and the covering lava beds, which are cut off in "high cliffs" where the range falls abruptly to the Gulf coast (p. 42).

It is highly significant that here as well as at two other points farther north, Santa Rosalia and Mulege (Muleje on the map), where the coast at the eastern base of the lava-covered ranges was reached, no mention is made of volcanic rocks reaching the sea level; although, had the eruptions occurred after the uplift of the mountain blocks, occasional lava cascades down the eastern scarps—like those which plunge into the western part of the Colorado canyon—might have been expected. It is true that the journey over the southern ranges led at one time "through the broken plateau country among scattered volcanic crater cones which rise from about 300 to 1,000 feet above the general level. Each cone is the center of a series of lava beds which spread over the surrounding plain" (p. 38); and from this it might be inferred that the cones and flows were of recent origin; but the next sentence tells, as already quoted, that "canyons of varying depths gash the surface of this great volcanic plain" and thus throws the date of the eruptions so far back that they must have preceded the mountain upheaval. Post-faulting eruptions must be relatively rare. The greater volume of the lava beds appears to have shared the uplift as well as the erosion of the present mountain masses; and, if so, then this part of the peninsula must have been, in its pre-faulting stage, a desert lava plain, and must be, in its present stage, a moderately dissected fault-block mountain, like the San Pedro Mártir range.

In any case, the Sierra de la Giganta, about 80 miles in length, with summits from 2,500 to 4,500 feet in altitude, is represented on the map as having a distinctly unsymmetrical, fault-block form, with a steep escarpment falling off in 5 or 10 miles to the Gulf shore line and a gentler slope largely lava-covered, descending for 30 or 40 miles on the west. It would be highly interesting from a physiographic point of view to learn whether this southernmost lava-covered range may not be a homologue of the lava-covered Natanes ranges in western New Mexico, long ago incompletely described and explained by Gilbert in his first season of western work, and of the similar Humboldt ranges of Nevada described thirty years later and convincingly explained as tilted fault blocks by Louderback. If any future explorer attempt to solve this problem it would be well for him to examine not only the main Sierra but also the small islands in the Gulf a little east of the Sierra escarpment; for, according to the fault-block theory, these

islands should be little-lifted chips of the great mainland block, and as such they should show the lava beds on the sandstones at a relatively low level.

Intermont Basins

A number of elongated intermont basins occupy the depressions between the ranges in the northern half of the peninsula and are as manifestly aggraded depressions as the ranges are dissected uplifts. The basin of San Felipe, above-mentioned as lying beneath the great escarpment of the Sierra San Pedro Mártir, is one of the largest examples; it is about 70 miles in length and 10 or 15 in width. Great alluvial fans slope into it from the canyons in the high escarpment: they are strewn for a mile or more from their apex with boulders up to 6 or 8 feet in diameter, which testify to the enormous force of occasional floods. Small streams in the canyons, following the nymph-like habit of streams in desert mountains elsewhere, advance a short distance out upon the fans in the cool hours of the night and may be still found there in the early hours of the next morning; but during the heat of the glaring day they retreat a mile or more into their rocky fastnesses. No mention is made of any recent fault scarps across the fans near the base of the great escarpment, as indicative of a recent renewal of up-faulting, nor of the termination of the inter-canyon spurs in steep triangular facets, indicative of the inclined fault plane on which the enormous displacement of the mountain block originally took place. As such features are associated with certain fault-block ranges in the Great Basin of Utah and Nevada, they may possibly be found here also, and, although of little importance biologically, they are of much interest physiographically.

Rate of Geologic Change

The weathered boulders on the mountains and the washed boulders on the fans are taken to prove that geological changes in this arid region are progressing actively. Thus an account of the Sierra Juárez describes its summit highlands as "a rolling mesa . . . with low, usually bare, granite ridges and gigantic piles of huge rounded rocks. These rocks were often too huge and smoothly rounded to be climbed by a man. They were evidently the results of rapid decomposition of the granite" (p. 15). Again it is said that "everywhere among the granite mountains the disintegration is very rapid, as evidenced by the vast sloping accumulations of sand, gravel, and boulders" (pp. 50, 51; also 54). It may be questioned whether this inference is correct. The results of weathering and the work of transportation are truly very manifest, yet the weathering may be exceedingly slow, and the transportation is so long interrupted between its spasms of activity after cloud-bursts that its average rate may be deliberate. Until the time that these processes have been in operation is known, as well as the quantity of work that they have done in that time, their rate cannot be well determined; and in the meanwhile the average rate may be better regarded as leisurely than rapid.

The Open Plains of the West

Besides the well-enclosed intermont basin plains there are several open plains on the western side of the peninsula which in part reach the ocean. The largest of these are the plains of the Vizcaino desert at the peninsula mid-length and, farther south, those of Magdalena, which stretch along the western base of the Sierra de la Giganta and wrap around its southern end in a low isthmus, thus tying the former island of the Sierra de la Victoria to the mainland. The Vizcaino plain occupies a triangular depression, about 80 miles on a side, open to the northwest. At its northeastern angle the plain enters a constriction between the northern granitic ranges and the southern lava-covered ranges. The southwestern side of the triangle is limited by the outstanding Sierra Vizcaino, "mainly volcanic", which is continued northwestward into the ocean, thus forming the curious horn by which the Pacific side of the peninsula is characterized; the horn is extended by several islands. The broad plain in the depression thus enclosed appears to have been aggraded chiefly by detritus from the larger mountain ranges of the peninsular axis, as its surface rises inland towards them and reaches an altitude of 1,200 feet at their base. The open side of the plain, between the Vizcaino horn and the northern ranges, has a curved re-entrant shore line, presumably determined by the sweep of the ocean waves and currents; the re-entrant is occupied by Sebastian Vizcaino Bay. The Sierra Vizcaino approaches the lava-covered ranges at the southern angle of the triangular plain, but the plain continues through the gap and beyond in a narrowing southward extension for 70 miles; here it again has a curved re-entrant shore line bordered by sand reefs and fronted by Ballenas Bay. Unfilled lagoons of moderate area occur behind each of the re-entrant shore lines, thus indicating that the triangular depression is not yet so well filled as it may come to be in the future. The exceptionally great breadth already attained by the plain is evidently due to the protection afforded by the outstanding Sierra Vizcaino, formerly an island, against the waves of the Pacific.

The Magdalena plain, about 180 miles in length and 40 in greatest width, is similarly conditioned, although the outstanding island ridges that protect its middle and most advanced part from abrasion are much smaller than the Sierra Viczaino, and although the plain behind them has less completely filled the enclosed waters. North and south of the protecting islands the narrowing plain is fronted by sand reefs and beaches which stretch in long sweeping curves concave to the ocean until they become tangent to the mainland, thus repeating the corresponding features of the Vizcaino plain. The much smaller plain of San Quintín, west of the San Pedro Mártir range in the northern part of the peninsula, shows similar features. The similarly small plain of San Bruno fronts the Gulf coast at the base of a re-entrant in the steep scarp where the northern segment of the lava-covered ranges descends to sea level; the middle of its front is pro-

tected as in the other examples by an offshore island. A little farther south the longitudinal depression behind two larger islands is shown on the map to be occupied by a plain for the southern half of its 60-mile length; its unfilled northern half holds Concepción Bay.

Shore Line Changes

In view of these detrital plains, and of certain other features, Nelson concluded that formerly "the peninsula was partly submerged and then arose slowly with approximately the outline it possesses today but considerably greater in extent. Since then it appears to have been steadily reduced through erosion by the sea" (p. 53). This conclusion does not seem well assured. There is no question that the sea has done some work in cutting back the rocky salients of the coast, as is clearly shown by the abundant sea cliffs; nor that much gravel and sand have been swept by the waves and currents along the concave beach lines of the open plains. But emerged shore lines backed by abandoned sea bluffs or cliffs are not mentioned in the text or shown in the few views of the coast; and in their absence a recent elevation of the peninsula as a whole seems improbable, to say the least. The only features which may possibly represent emerged shore bluffs are two 50-foot scarps, apparently trending north and south, which are briefly mentioned as interrupting the gradual inland ascent of the Vizcaino plain in its northern part; one is 3 miles from the shore, the other is 26 miles farther inland. The text gives no hint of their origin. As similar bluffs were not found on other parts of the Vizcaino plain, or on any part of the 100-mile traverse of the Magdalena plain, the 50-foot bluffs above mentioned may be recent fault scarps. Hence, instead of inferring that the last change of level has been a general elevation of the whole peninsula, it seems more plausible to suppose that the chief recent movements in the region have been local and diverse emergences and submergences associated with block faulting. Indeed, some of the emergences may have been followed by later submergences, also relatively local; for the Gulf coast of the southern half of the peninsula exhibits irregularities of outline that suggest a recent drowning of moderate amount, after the scarps and slopes of the displaced fault blocks that form the mainland ranges and a number of small neighboring islands had been significantly dissected.

As to the inferred steady reduction of land area through erosion by the sea since the supposed elevation of the peninsula, the rocky headlands have, as above noted, evidently enough been somewhat cut back, but the moderate height of the resulting cliffs does not indicate a great recession of the shore line. Indeed, any cliffs that have been cut at the base of the long western slope of the San Pedro Mártir mountain block where it descends to the Pacific shore and is openly exposed to attack by ocean waves, are not so high as to excite especial remark in the narrative of the days spent on that part of the coast; the actual shore line there lies for a considerable distance on a belt of beach dunes which enclose a narrow salt marsh or

coastwise plain outside of "the low rolling foothill plateau" (p. 24). Indeed, along many other stretches of the coast also the land has gained on the sea by the formation of detrital plains, not only the greater ones described above, but many smaller ones also. Thus the steep eastern slope of the Sierra de la Giganta is fronted, in the southern part of its length at least, by "a sandy coast plain 2 or 3 miles broad" (p. 42). Further evidence of small recession of the shore line by wave cutting is found in the rapid descent of the sea bottom from the shore into deep water around the headlands; for example around the southern termination of the peninsula near Cape San Lucas, as shown on Hydrographic Office chart 1664; and around the western headlands of the Sierra Vizcaino, as shown on charts 1268 and 1310. On the whole it would seem that the gain resulting from the addition of detrital plains may be measured in miles, while the loss by cliff cutting should be reckoned only in furlongs.

Climate: Aridity of the Peninsula

Space does not permit an adequate continuation of this notice through the chapters on climate, flora, and fauna; but a few extracts from them may serve to illustrate the rich fund of interesting material that they contain. Aridity is the leading feature of the climate, in spite of the peninsular pattern of the land between a great ocean and a large gulf. Nelson calls attention to this fact and wisely adds that the production of artificial sheets of water, like the Salton Sea near the lower Colorado—to which may be added the proposed flooding of the "shotts" in the northern Sahara and the construction of lakes near the border of the Kalahari—with the object of modifying the climate of the adjoining deserts, must be fruitless. It is not so much an increased water surface for evaporation that is needed in such regions as an alteration in the régime of the winds, whereby they may be provoked to precipitate the moisture that they already possess; and that is beyond man's power—at present.

The scarcity of water throughout Lower California is such that even the plunge pools cut in the mountain-slope canyons below the cascades of temporary wet-weather streams are prized as drinking stations, though some of them are so inaccessible between close-set canyon walls that water can be drawn from them only by rope and bucket. The stream courses across the detrital plains are usually dry—they would be called wadis in northern Africa; but water can often be found by digging beneath them, especially in the lower part of the plains near the coast. Rain is, however, more frequently reported in Nelson's narrative than the reputation of the peninsula as a nearly rainless region would lead one to expect; and the few inhabitants have many stories of cloud-bursts and destructive floods. Thus in the northern section of the lava-covered ranges a rain in October, 1911, caused a flood which swept down a canyon with a front wall of water from 12 to 15 feet high, drowning 23 persons, destroying 39 buildings, and causing much other damage; hence the rule that death by drowning is a char-

acteristic though not common accident in desert regions is well supported. Floods sometimes inundate the lower parts of the detrital plains: in December, 1905, Nelson's party traveled on the Magdalena plain "for nearly two days through broad shallow ponds and many swiftly flowing streams in the washes. . . . It was a curious sight to see miles of giant cactuses and other characteristic desert plants standing in the midst of broad half-submerged expanses" (p. 100).

The latent fertility of the plains is strikingly illustrated by the effects of passing showers, the course of which is marked for several following weeks by belts of verdure across the barren desert. On the small plain of San Bruno, above-mentioned as occupying an island-protected re-entrant of the Gulf coast, the travelers saw in October "a belt of green a few hundred yards wide, like a broad ribbon across the brown plain, showing where a heavy shower had passed over the country some weeks before and wet the ground sufficiently to bring up the grass and other herbage" (p. 35); and again in November on the northern part of the Magdalena plain the party "crossed a broad belt of country in which there was a good fresh growth of grasses and other herbaceous vegetation, 4 to 6 inches high, most of which was ripening its seeds. Some ranchmen . . . told us that a heavy rain fell here on August 7, which resulted in this growth. Just before nightfall we suddenly passed the border of this belt of green into the brown arid desert again and in order to give our stock the advantage of the fine pasturage were obliged to turn back and re-enter the green belt" (p. 39).

Vegetation

A description of the desert vegetation of arid mountains and plains in geographical, not botanical, terms is a difficult art, not yet well developed. Repetition of the generic names of the innumerable cactuses—Echinocactus, Lemaireocereus, Mamillaria, Pereskiopsis, Wilcoxia, and the like—however instructive to botanists, does not furnish a geographical picture of the peculiar Lower California flora, so unfamiliar to residents of temperate and well watered regions. The creation of such a picture is truly difficult. The open-growth patches of small-tree pine forests on the slanting rocky highlands of the block mountains, above mentioned, may be easily conceived; but it is quite otherwise with the wide-spaced growth of the cirio, a remarkable tree, 20 to 50 feet high, peculiar to Lower California and constituting the prevailing species for hundreds of square miles on the granitic highlands; "the tapering yellowish trunk and rootlet-like branches give the cirio a close resemblance to a gigantic slender parsnip bottom side up" (p. 106 and Pl. 29). Similarly, the plant monstrosity known as the elephant wood contributes an utterly strange aspect to the landscape; it "has a short thick trunk and contorted branches covered with a smooth, skinlike bark which lies in thickened folds and creases, giving the tree a dropsical appearance" (p. 106 and Pl. 28).

A good instance of the utility of translation from botanical into geographical phrasing is afforded by the description of a peculiar cactus occurring on the Magdalena plain. Here a single locality was found to be occupied by an extraordinary thick-stemmed creeping cactus with upcurved ends: "these curious plants radiate from a central point, and while the parent stem dies the continual growth at the front end causes the separate stems actually to travel away from the starting point" (Pl. 14, opp. p. 40). This can be fairly well conceived by geographers, and, although the impassable cactus patch is of small area, it deserves mention along with many other small items, such as a little mud volcano on the delta of the Colorado River at the head of the Gulf, a salt bed on the eastern side of the Vizcaino desert plain (both these items are shown on Pl. 21, opp. p. 52), and a sea-turtle corral on the shores of a lagoon near the northern border of the Vizcaino plain, from which 1,000 turtles are shipped monthly to San Diego (Pl. 12, opp. p. 33).

Animal Life

Description of the animal life of the peninsula like that of the vegetation needs translation from biological into geographical phrasing. The whales, seals, and sea otters, formerly abundant on the coast, may now be lightly passed over as they have been nearly killed off. The numerous small rodents of the detrital plains, being largely of nocturnal habit, contribute little if anything to the landscape. The mountain lions, wildcats, antelope, deer, mountain sheep, coyotes, badgers, and foxes are easily listed; but the listing gives little indication of the share that these residents add to the outdoor picture of mountains and plains. It may be noted, however, that the share added by the antelope and the mountain sheep is a vanishing one, for they are on the way to extinction by hunters, such being the unhappy effects of upsetting the "natural balance of powers" by the advent of civilized man. "The mountain sheep is still widely distributed on the main mountains of the eastern half of the peninsula but, in addition to being hunted for sport, is being slaughtered without regard to age or sex to supply mining camps and small towns with meat" (p. 110).

The great variation in the annual rainfall, characteristic of arid regions, causes a corresponding variation in the abundance of various forms of animal as well as of plant life. "During series of consecutive heavy rains the desert vegetation flourishes exceedingly, great quantities of seeds are ripened, tender vegetation abounds, and desert mammals, especially the small [rodents] . . . increase enormously until favorable areas swarm with them. When the long rainless period follows, the herbage ceases to grow, no seeds are ripened, and there is a resulting scarcity of food, and an enormous mortality among the small inhabitants of the desert" (p. 111). The active but short-lived growth in certain elements of the fauna after a rain recalls the belts of verdure that for a short time mark the tracks of heavy showers on the detrital deserts. An earlier explorer, Eisen, is quoted

on this point. After the first summer rains in the southern part of the peninsula, "nine-tenths of all chrysalises and larvae hatch at once, and the whole country is teeming with animal life. The bushes and trees cover themselves with leaves and flowers, giving ample food for caterpillars and insects of all kinds. . . . A week after the first rain the fauna is at its height . . . Countless lizards dart among the rocks on the hillsides or in the branches of the trees. . . . Myriads of butterflies are seen filling the air in the daytime . . . When at such a time a cloud over the sun caused a temporary shadow the innumerable host of butterflies suddenly vanished, having taken refuge on the underside of the leaves of trees, bushes, and herbs" (p. 113). Vivid descriptions of this kind make an excellent picture; and, if preceded by a correspondingly vivid account of the land forms, they enable the reader to form a mental reproduction of the region concerned that is truly geographical.

The Human Element

As to the human elements in the geography of Lower California, an aboriginal phase and some modern phases may be briefly touched upon. The native tribes, although of a very primitive order and not practicing agriculture when first known, appear to have become about as well adapted to their arid surroundings as have the desert plants. They probably had their periods of increase and decrease as determined by periods of varying rainfall; but since the coming of invaders of European stock their numbers have continually decreased from an original total estimated at 25,000 to a mere handful; only a few hundred survivors now remain. Their original condition was probably a delicate balance between savagery and aridity; when the balance was disturbed by invaders the aridity conquered and the savages dwindled away. There is no great satisfaction in that story. Nor is satisfaction found, after passing over the Spanish-Mexican colonization period, in the account of certain modern schemes to people the empty detrital plains with civilized farmers. A part of the Magdalena plain "was once the site of a disastrous attempt to establish an American colony and met the fate certain to overtake any ill-judged effort to settle this region without the proper preliminary work" of constructing storage reservoirs in the mountains and digging wells and cutting canals on the plains. Nelson remarks: "The large number of ruined and abandoned missions and ranches seen along our route was a strong warning against inconsiderate settlement of such areas" (p. 138).

Mining has been successful occasionally, moderately, locally, and temporarily, as centuries count time; but who shall count its failures! While successful its feverish activity here and there makes small interruptions in the great expanses of desert solitude and silence; and its extravagant destruction of mountain sheep, as told above, is an incongruous element in the division of economic geography, where mining, geographically considered, belongs.

Cattle raising has its ups and downs; its best success is on the western slopes of the northern mountains; it has been much less successful on the southern plains, where large herds have been developed during a succession of favorable years only to be lost in a following dry period: thus large ruminants, artificially introduced, do not escape the unhappy fate of the little indigenous rodents. It cannot be a pleasing adventure that ends in the death of thousands of creatures from starvation and thirst.

Successful human endeavor in a region of this kind evidently demands a close knowledge of the country and its climate and a careful adjustment to their demands. Such adjustment may lead, in well chosen localities, to a fair livelihood for small groups of not over-exacting persons, persons who are capable of living frugally and patiently, of persevering through difficulties and persisting against discouragements; but it is not to be supposed that all inhabitants of the peninsula possess those fine qualities. Small ventures supported by locally represented capital would appear to lead to better results than larger ventures financed at a distance. Some new settlers might be content to raise goats on offshore islands and sell their skins if not their meat; others should be satisfied with gathering wax from wild bees' nests and increasing the export of this article above the 7,000 kilograms reported in 1918. Those inclined to agriculture might try raising sugar cane on irrigated piedmont fields and selling crates of brown sugar for shipment across the Gulf to Mazatlán; but the most discriminating would probably elect to raise subtropical fruits in the valleys of the Sierra de la Victoria at the extremity of the peninsula, where the climate is said to be the finest of its kind: but in spite of these attractive little opportunities, Lower California will probably long remain a better field for the explorer than for the settler.

It should be understood that the preceding pages are concerned only with a side issue of Nelson's investigation. He went to Lower California to study the distribution of birds and mammal life and its environmental relations; and the results of these studies are concisely and technically stated, largely as lists of generic and specific names, in the later pages of his volume. Those lists and the lessons that they teach will doubtless be reviewed in appropriate biological journals. What has been set forth here is simply a selection of striking and characteristic passages, chiefly involving geographical descriptions, which, although related to the main object of study as constituting the inorganic environment of the bird and mammal fauna, are nevertheless subordinate to it. Surely this is a rich memoir, if its subordinate results are so interesting and instructive.

THE DISTRIBUTION OF POPULATION: A CONSTRUCTIVE PROBLEM

By M. Aurousseau
Geophysical Laboratory, Carnegie Institution of Washington

Everyone who takes an interest in public affairs feels that population presents a vital problem. We are not by any means agreed as to the precise nature of the problem nor, indeed, as to why it is a problem at all. The great majority of ordinary individuals, especially those engaged in affairs of government, have a fixed idea that it is of necessity a question of encouraging increase. In two countries, France and Holland, we find striking exceptions; but almost everywhere else in the world the birth rate is regarded as the criterion of progress, and any diminution of birth rate is looked upon with the gravest anxiety and with an utter disregard of all other statistical variations of the population. Efforts are made to encourage immigration and to foster natural increase; while Australia has gone to the length of distributing a maternity bonus in money. Many students of the matter hold, if not the reverse, at least a very different view. It is now one hundred and twenty-three years since Malthus made the greatest of all contributions to the study of population. The principles he then discovered have steadily gained ground with economists and men of science, until now some of them are regarded almost as laws of nature; yet, in spite of this, these principles have been steadily ignored by the rest of the world and, indeed, may be said to be unknown to the majority.

The state of affairs existing at the present time is sufficient to cause alarm not for the present generation but, at any rate, for the next but one. We are heading toward the crisis of not being able to provide food for our rapidly increasing numbers. The whole matter has been most lucidly and completely set forth by East, in what is evidently a summary of extensive research.[1] He shows that the white race is increasing much more rapidly than the yellow or the black. China is stationary, while India and the South Sea Islands are increasing spasmodically, probably at a somewhat slow rate. Japan is showing a steady increase. In the United States and the West Indies the blacks are increasing rapidly, and they are also increasing in South Africa; but the condition of the dark races of central Africa is doubtful. The great rate of increase of population in the United States is then considered in relation to the agricultural resources of the country. The whole exposition goes to show that, although the resources for the immediate future are ample, very serious conditions are likely to arise in a future which is not far distant. In the very month when East's paper

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[1] E. M. East: Population, *Scientific Monthly*, Vol. 10, 1920, pp. 603–624.

appeared, Pearl and Reed [2] announced the discovery of an empirical law of population increase which is of fundamental importance. These authors treated population increase as a biological growth problem. They deduced the formula of a logarithmic parabola, which fits the curve of population growth of a country with wonderful accuracy and indicates a definite upper limit, which is given remarkable confirmation by other biological growth phenomena which may be verified experimentally. They announce a maximum of 197¼ million for the population of the United States. That the United States could not support an "enormously greater" population is the further conclusion of East who in the light of additional data reconsiders the agricultural possibilities of the country.[3] He now states as his conclusion that 331 million people is the "maximum population the United States can support under any conceivable conditions to those of us who live at the present day." These investigations are an index to the most important work that has been done on the problem of population, and should do much to shake the faith of the uninformed majority, which thinks that the maintenance of an alarming rate of increase is the only possible way of keeping our place in the race of nations. The state of the world's food resources has been investigated by J. Russell Smith,[4] who shows that by the geographical extension of areas under cultivation, by increasing yields, by new inventions and discoveries, etc., the resources now in sight may be extended to an extraordinary degree. Von Engeln, in reviewing Smith's work, points out that, although numerous means of extension *may* be available, human nature is an obstacle in the way of their utilization, and considers that our food resources cannot expand indefinitely.[5]

Mackinder has drawn attention to another great factor in pointing out that society is a "going concern" and therefore has momentum.[6] At the present time, in spite of the recent war, three great powers are forging ahead with tremendous momentum toward the same economic objective. As three rivals cannot attain and hold the same objective, such a trend leads to conflict unless the momentum, which is largely the result of expanding population, be checked.

There is, then, a pressing problem of population, which is twofold in its nature. First, we must set ourselves to find some means of occupying the habitable lands to the best advantage; secondly, the fundamental causes of increase must be investigated, and methods of control may have to be devised and applied. The first part of the problem is largely the concern of geography, and it is my purpose in this paper to show that the means are at hand whereby we may take an active step towards its solution.

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[2] Raymond Pearl and L. J. Reed: On the Rate of Growth of the Population of the United States Since 1790 and Its Mathematical Representation, *Proc. Natl. Acad. of Sci.*, Vol. 6. 1920, pp. 275–288. For a popular account, embodying further results, see Raymond Pearl and F. C. Kelly: Forecasting the Growth of Nations, *Harper's Mag.*, Vol. 142, 1921, pp. 704–713.

[3] E. M. East: The Agricultural Limits of Our Population, *Scientific Monthly*, Vol. 12, 1921, pp. 551–557.

[4] J. Russell Smith: The World's Food Resources, New York, 1919.

[5] O. D. von Engeln: The World's Food Resources, *Geogr. Rev.*, Vol. 9, 1920, pp. 170–190.

[6] H. J. Mackinder: Democratic Ideals and Reality, New York, 1919.

Expansion of Population

During the recent past the European countries, under intense industrial development, have been responsible for the huge expansion of the world's population. Internal pressure has caused them to seek an outlet for the overflow, and the rest of the earth has been exploited and used as a dumping ground for the surplus. Only a limited portion of the earth, however, has proved suitable for the transplanted European as a permanent home; and the temperate zones of both hemispheres have shown, in consequence, the greatest power of absorption. The emigrating peoples have not taken kindly either to the tropics or to the colder latitudes where empty spaces are available. The relief afforded the older countries by extensive emigration of their people has resulted in an acceleration of increase at home. The new occupants of the lands overseas also increase at a greater rate than they did at home, and the difficulty remains only temporarily solved. Moreover, after a time, the new states established overseas begin to feel that their own rate of increase gives them power to develop their territories independently, without further accessions of population from the home lands. This is the growing attitude of the United States at the present time. To be sure, Canada, Argentina, South Africa, and New Zealand still give a warm welcome to the immigrant and would not assent to my statement; but the attitude of labor in Australia towards immigration is somewhat hostile, and the phases through which the United States has passed may be taken as a gage of the course of events in all the newer lands. When the pressure is really felt in these lands it will enforce an expansion into latitudes which have so far been shunned. In the southern hemisphere, except to a limited extent in Argentina, people will be forced by geographical conditions to expand into the tropics.

In view of these facts it is of the utmost necessity that a complete study be made, first of all, of the present distribution of mankind, of what Jefferson has called "the distribution of men over the earth as a static fact." As data we have the vital statistics of nearly all countries, some of them eminently useful, others very poor and inaccurate. Vidal de la Blache has given the study a starting point in a qualitative way.[7] He has summarized present conditions, noting the irregularities of distribution and the concentration in the temperate zones. He traces the origin of present conditions and distinguishes the main groups of mankind. His conclusion is that man has everywhere taken the road of least resistance, whether the resistance be climatic, topographic, or biologic, and points out that the best available land is always the first to be occupied. In a more specific manner Jefferson has outlined the precise limits of the study and has given consideration primarily to the cartographic aspect of it. He has shown clearly the value of cities as a measure of our occupation of the land and has evolved a

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[7] P. Vidal de la Blache: La répartition des hommes sur la globe, *Ann. de Géogr.*, Vol. 26, 1917, pp. 81–93 and 241–254.

method of cartographic representation of this aspect of distribution. He suggests, as an important principle, that "roughly level expanses of soil are almost more important for a great population than rainfall."[8] These two studies are a sound foundation for future work, which must be concerned chiefly with cartographic representation. We have already a rough quantitative idea of the distribution of mankind; but much greater precision is necessary, and, above all, we need good maps.

It is not likely that mankind will ever be distributed in an even fashion over the globe, and the trend indicates that the empty areas capable of absorbing the overflow are strictly limited in extent. With a precise knowledge of the present distribution as a foundation we shall be forced to turn to the necessity of making better use of what we already have, and in order to do so we need to know the *expansion ratios* of our various lands.

The Expansion Ratio

This quantity, which I believe is capable of evaluation, is defined as *the ratio of the extent to which a given area is already occupied, expressed in numbers of people, to the extent to which it may be occupied, either by lateral spreading or by internal readjustment, similarly expressed, under standards of living comparable to those of the present.* I submit that the evaluation is to be obtained by the proper delimitation of natural regions, combined with a knowledge of the grouping of the population in those regions. If the expansion ratio of an area be known, the next step is to make gradual use of the local margin which it indicates; and this is only to be brought about by educating people to the value of the information—a different matter from that of providing them with the information.

Travel in England or Scotland soon convinces one of the reality of the expansion ratio, and travel in France or Belgium indicates that its absolute value is likely to show considerable variation from region to region. In some regions we may anticipate a liberal figure, while for others it may be close to unity. Until we are able to give it a real significance and can show people why a margin exists, little advance is likely to be made. Much is known of the grouping of population, but the information is unrecorded and can only be properly gathered by familiarity with the various regions. It is not yet possible to construct a map showing those areas where people live exclusively in villages, or in small village communities, or on farms scattered half a mile apart, or three miles apart, etc.; but the information only awaits collection and interpretation. The study of natural regions is more debatable ground, and many will query what is meant by the term. The indications here also are promising and, I believe, sufficiently definite to warrant the use of the information already gained. Most satisfactory of all is the fact that we possess the organization and part of the machinery for the education of

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[8] Mark Jefferson: Some Considerations on the Geographical Provinces of the United States, *Annals Assoc. Amer. Geogrs.*, Vol. 7, 1917, pp. 3–15.

the public to the value of our work. One study somewhat of the kind suggested here has already appeared.[9] It deals with an enormous area and a great range of conditions, and its conclusions may require subsequent modification; but the results are brilliant, and the study stands alone as an able piece of pioneering work. In a more general way Mill has considered the broad question of increasing the use of our lands and recommends extensive mapping, largely of a geological nature, as the groundwork of a more natural layout of minor administrative areas. He also admits that it is necessary to secure the right sort of people, people with the power of doing work.[10] Dickson has attacked the problem in another way and also recommends extensive geographical survey and mentions the need of a stock-taking of our resources and of some sort of "country planning." [11]

The Grouping of Population

In the quantitative study of population we refer to density, distribution, and arrangement. It is necessary to understand clearly what these terms mean. Density concerns itself with the number of people per unit of area; distribution deals with the comparative study of density from area to area; and arrangement considers the way in which people are grouped. Grouping is the fundamental concept, and our representations of density and distribution are somewhat artificial methods of expressing the variations of grouping. The ordinary map showing areal density assumes an even grouping for each of its limits of area. The results do not represent the facts but, on maps of small scale, give a reasonable idea of how the earth is occupied. As most of these maps endeavor to represent the rural population and often leave the towns out of consideration, a clearer picture is given by Jefferson's town maps, the presence of a town or group of towns generally postulating a surrounding rural halo. The map that can depict grouping faithfully has yet to be devised.

Urban and Rural Groups

For the average man the population of a country seems to fall naturally into two sections, rural and urban. The terms have definite significance for us; and, although Jefferson has insisted with perfect logic on the unity of the city and country,[12] in actual practice it is desirable to separate the two elements. A brief consideration shows that there is no sharp line of separation between them, but they represent opposite ideas to us. The townsman is a very different fellow from the countryman, and, however intimately his life may be linked with that of the latter, in a town of any

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[9] Griffith Taylor: Geographical Factors Controlling the Settlement of Tropical Australia, *Queensland Geogr. Journ.*, Vols. 32–33, 1918, pp. 1–67; *idem:* The Settlement of Tropical Australia, *Geogr. Rev.*, Vol. 8, 1919, pp. 84–115.

[10] H. R. Mill: The Development of Habitable Lands: An Essay in Anthropogeography, *Scottish Geogr. Mag.*, Vol. 16, 1900, pp. 121–138.

[11] H. N. Dickson: The Redistribution of Mankind, *Geogr. Journ.*, Vol. 42, 1913, pp. 372–385.

[12] Mark Jefferson, *op. cit.*, p. 6.

size he seldom gives a thought to the countryman or the country. The relation between urban and rural elements may be illustrated by the analogy of an isomorphous mineral series. In the mineral series all compositions are possible for the individual, from 0 per cent B. 100 per cent A to 100 per cent B. 0 per cent A. The mineralogist, though never losing sight of the true continuity, gives different names to individuals whose compositions lie near the extremes, as forsterite and fayalite in the iron-magnesia olivine series. In the mineral series we often find that the commonest individuals have compositions, say xB. yA, which fall near the middle of the series well away from the extremes—individuals of extreme composition, or of 100 per cent purity of one component, being correspondingly rare. Population is such a series, in which the possible ranges of composition lie along the line 0 per cent urban. 100 per cent rural . . . 100 per cent urban. 0 per cent rural; only here the commoner compositions do not lie near the middle of the series but tend to approach the extremes, though they may never actually reach them. The average example represents one or the other extreme; and, if the mineralogist is able to make his distinctions in nomenclature and can still keep in mind the absolute continuity of his series, surely we are justified in making a similar separation and in terming rural those sections of the people who are spread over the countryside and are engaged in the production of the primary necessities from the soil, while the dense clusters of folk, who have no immediate interest in the production of the materials for their food and clothing or general comfort, but are engaged in transporting, manufacturing, buying, and selling them, or in educating the people, or in managing the affairs of the state, or in merely "living in town," become the *urban* section. Just as the mineralogist has to apply different methods of analysis in dealing with his extremes, the rural and urban extremes of the population series require somewhat different geographical treatment. The principles underlying the distribution of towns and cities are extensions of those governing the occurrence of farms and villages, but the extensions do not apply to the latter.

Urban Groups

If the state be regarded as an organism, the towns and cities are its organs. They are brought into existence by the growing complexity of the organism. Usually they grow from small, rural beginnings, but they may be created by spontaneous action. Although a great deal of attention has been given to towns, geography does not yet seem to have got to the root of the matter in interpreting these complex and baffling groups. Most investigators have been attracted by the interest surrounding the origin and situation of towns. Origin is an unfruitful line of investigation in the old countries and leads one sometimes to nothing more satisfactory than a legend or fairy tale. Situation gives better results. Long ago Ratzel pointed out that there are two kinds of situation: *site*, or topographical situation; and *position*, or geographical situation. This distinction deserves

more prominence. It has indeed been usefully employed by some of the French geographers. Raoul Blanchard in his town studies has emphasized distinction of *site* and *situation*. Site is a rural attribute, but position belongs to urbanism. Position represents a combination of advantages—the "strategic position" of Jefferson—which are crystallized in Mackinder's idea of "nodality."[13] The majority of studies of towns trends towards the cataloguing of positions, and we now have an extensive knowledge of the kinds of advantages offered by different positions.[14] It has also been shown that a town may enjoy prosperity owing to its position and yet have a very poor site.[15] When we examine the idea of position in an abstract way it is at once evident that function is the driving force in the life of towns. The tissues of the state (the rural folk) or mayhap the other organs demand that a function be discharged for them. A town comes into being either at a point having those characteristics of nodality which enable it to discharge that particular function to the best advantage or at a point artificially endowed with nodality. The town will continue to flourish in the discharge of its function until the state finds that it no longer requires the assistance given. The fundamental geographical relationships of towns now become somewhat clearer. In a given state we are able to discern two orders of towns, the *active* and the *inactive*. Of active towns there are six classes.

The Six Classes of Active Towns

The towns and cities of the present day function towards the nation rather than the race. Within the national boundary are numerous urban groups which exist for the exercise of the following six functions: administration, defense, culture, production, communication, recreation. These terms are used in their widest sense; and, inasmuch as all towns are placed in nodal situations, many are conveniently situated for the discharge of more than one function. There is generally one phase of activity, however, which overshadows the rest.

1. The capital city is the type of town existing for the purpose of *administration*. It is often a unifunctional town and may be a conscious creation on the part of the nation (Washington, D. C., and Canberra, Australia). It should be, but often is not, situated centrally, with due regard to ease of communication, strategic advantage, and climatic conditions. The only town studies I am aware of which deal with cities in a functional way are two reviews of some of the principal capitals.[16] The administrative function towards subdivisions of the national area is almost always assumed by towns

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[13] H. J. Mackinder: Britain and the British Seas, New York, 1902.

[14] See, e. g., B. B. Dickinson: The Position of Towns, *Geogr. Teacher*, Vol. 1, 1901–02, pp. 97–108; Étienne Clouzot: Le problème de la formation des villes, *La Géographie*, Vol. 20, 1909, pp. 165–176; J. W. Page: The Geographical Factors Controlling the Sites of Towns, *Geogr. Teacher*, Vol. 6, 1911–12, pp. 266–270; G. G. Chisholm: The Situation of Towns as a Subject of Teaching in Secondary Schools, *Scottish Geogr. Mag.*, Vol. 30, 1914, pp. 505–518.

[15] A. Allix: La position géographique des grandes villes allemandes, *La Géographie*, Vol. 29, 1914, pp. 41–47.

[16] Frederick Homburg: Capital Cities, *Journ. of Geogr.*, Vol. 19, 1920, pp. 8–15; C. B. Fawcett: The Position of Some Capital Cities, *Geogr. Teacher*, Vol. 9, 1918, pp. 238–243.

important primarily for some other function but conveniently placed for administrative purposes. In a sense all towns have an administrative relation towards their own immediate areas. Some frontier and coastal towns at which customs are collected (revenue towns) are a specialized form belonging to the administrative class.

2. Towns discharging the duty of *defense* (not to be confused with self-defense, which belongs to a past age) are placed for the strategic advantages of the position and occur in definite relation to frontiers and routes. They tend to be peripheral. As types the fortress town, the garrison town, and the naval base are examples. These towns are often small and otherwise unimportant but are not always unifunctional; indeed, many of them, such as Liége, are great centers of industry. Since the failure of Antwerp, Liége, and Namur to discharge their prime function we have been confronted with a new problem in the evolution of defensive towns. Old defensive towns contribute largely to the number of inactive towns in many countries but some have retained their original prosperity by taking on new functions.

3. The university towns, many cathedral towns, and the centers of art and religion—including centers of pilgrimage—serve for the main purpose of *culture*. The term, for want of a better one, is used in rather a wide sense. These towns have no regular distribution, though many of them occur at the junctions of old routes. Their origin is very hard to trace, and the search for it often ends by unearthing a legend. As a class these towns are characterized by a remarkable capacity for retaining their vitality through long periods of time, many of them being of the remotest antiquity. Many of the English cathedral towns are entering the inactive order.

4. Cities concerned with *production* are important either for their bulk manufacture or for their particular craft. Their positions are often rigidly dictated by sources of power and, in many examples, by the presence of the necessary raw materials. In the coming age of hydro-electric power choice of position will be more elastic and will probably lead to the rejuvenation of many inactive towns which at present do not belong to this class. The climatic factor exerts an important influence in some of the textile manufactures, such as the cotton industry of Lancashire. Manufacturing cities are of relatively modern growth, but centers of craft are often ancient. Many of the cities of India arose through the Mogul custom of establishing temporary capitals, which were really immense and luxurious armed camps, draining the resources of the empire for their splendor. When the camp was moved enough craftsmen were sometimes left behind to give the site importance and vitality, which account for the existence of a city at the present day.[17]

5. Towns and cities acting as links in the chain of *communication* are of great variety and number, the function including all acts of transit from mere travel to the transport of goods. Many towns of this class have long been accorded a place in geographical literature, owing to their obvious economic importance. They may be classified in three groups, concerned

[17] Sir H. S. Maine: Village-Communities in the East and West, 7th edit., London, 1913, pp. 118–119.

with the three major divisions of the main duty, *collection*, *transfer*, and *distribution*. In the first group are the centers for the handling of primary products, the depot towns of agricultural and pastoral districts, mining towns, fishing towns, and forest towns. It may perhaps be argued that these belong to the preceding class, but in this case the towns themselves are not directly concerned with the act of production: they exist for the collection of the products; the mines, fishing banks, and forests corresponding geographically to the farms and pastures of ordinary rural districts. That the mines and their towns may sometimes almost coincide in locality is only a limiting case of the idea. These towns are urban groups with more than the usual amount of the rural element in them.

The duty of transfer devolves on the market towns, fall-line towns, break-of-bulk towns, bridgehead towns, towns at the tidal limit, towns at the head of navigation, and the *entrepôt* cities. Owing to improved means of transportation, towns at the tidal limit are decreasing in importance.[18] The term "head of navigation" is purely relative, as it depends upon the type of vessel considered. On the same river there may be one head of navigation for seagoing vessels, another for commodious river craft, and a third for barges, each of which fixes the position of a town.

To the third group are assigned the export and import towns (between which there is little difference) and the centers of general distribution. The last named constitute an important element, apt to be overlooked but embracing a large number of towns having no apparent function. They perform the opposite function to the depot towns of the first group and need the convenient name of supply towns. Communication, then, engages a large proportion of the towns and cities of a modern nation. These towns tend to occur in series along the great routes, on the navigable rivers, and on the coasts. Most important of them all are the great *entrepôt* cities, the relations of which are international. Concerned chiefly with the wholesale transfer of goods and traffic from opposite directions, they are also deeply involved in the work of collection and distribution and embrace the characteristics of the whole class. They are often of quite modern growth.

6. The sixth functional class, which exists for the purpose of *recreation*, includes the health, tourist, and holiday resorts. These towns occur at points offering some strong or novel attraction of climate, scenery, or social conditions. Seasonal prosperity is their most noteworthy character. Many of them are of recent growth, and their activity is liable to fluctuation.

Table I renders clear the relationships expressed in the preceding pages but must not be regarded as a rigid classification. Geography is not a subject in which the ordinary classifications of science are either possible or desirable. The best that can be done is to provide a way of regarding things that shall be as natural as possible, enabling a clear appreciation of relationships to be made. The table, for instance, is constructed on a unifunctional basis, but it is sometimes difficult to decide which, of the several functions

[18] E. C. Semple: Coast Peoples, *Geogr. Journ.*, Vol. 31, 1908, pp. 72–90 and 170–187.

a plurifunctional city may have, is the most important. The dangers of the rigid attitude have been dealt with by Chisholm.[19]

The true significance of towns and cities cannot be fully expressed in formal terminology. A review of several large cities of the same order of importance illustrates this point. London, a capital city and an international *entrepôt* city of the first rank, appeals to us as the chief mouth of Great Britain. Paris, essentially a capital and a city of international intercourse, is the

Table I—The Active Order of Urban Groups, Tabulated According to Dominant Functions

Class I—Administration	Class II—Defense	Class III—Culture	Class IV—Production
Capital cities Revenue towns	Fortress towns Garrison towns Naval bases	University towns Cathedral towns Art centers Pilgrimage centers Religious centers	Manufacturing towns Craft centers

Class V—Communication			Class VI—Recreation
Group A—Collection	*Group B—Transfer*	*Group C—Distribution*	
Mining towns Fishing towns Forest towns Depot towns	Market towns Fall-line towns Break-of-bulk towns Bridgehead towns Tidal-limit towns Navigation-head towns	Export towns Import towns Supply towns	Health resorts Tourist resorts Holiday resorts
"Entrepôt" Cities			

Compare this table with the table of rural groups, *Geogr. Rev.*, Vol. 10, 1920, p. 239.

head of France in the physiological sense ("the lucid French people, in its brain town of Paris"—Mackinder). Berlin is a capital but more a city of internal than of international intercourse and was regarded as the control center of the former German Empire. New York, of the same order of magnitude, is not a capital but is a great center of trade and traffic and stands for the outsider as the gateway and business office of the United States.

The Decline and Rejuvenation of Towns

The chief factors that may lead to decline at the present day affect principally the towns of defense, production, and communication. The first class, in its present form, may suffer general decline owing to its incapacity

[19] G. G. Chisholm: Generalisations in Geography, Especially in Human Geography, *Scottish Geogr. Mag.*, Vol. 32, 1916, pp. 507–519.

to resist modern weapons. The productive towns are mainly influenced by changes in the sources of power. Towns which flourished on water power declined on the advent of coal and steam; and, in their turn, some modern manufacturing towns may be threatened by the development of hydro-electric power. Exhaustion of raw material acts rapidly on the mining towns, as is shown by the number of extinct mining centers in regions like Nevada, Colorado, and Western Australia. Similar results may be seen in the case of lumbering. The recent war has emphasized another aspect of the question in the deprivation of raw material, affecting the manufacturing cities that draw their supplies from beyond the seas; this is illustrated by the Manchester cotton famine. The towns and cities of communication depend upon their adaptability to the vehicles of transport. It is unnecessary to dwell on the effects of railways and canals, but the increase in the size of ships has had far-reaching effects in developing harbor towns at the expense of towns at the tidal limit or head of navigation. Changes in the vehicles of transport may bring about a shifting of the great routes, which will cause the decline of many towns.

Inactive towns may discover, after a long period of inactivity, that they are capable of reviving their usefulness. If the new function differs from the old, the rejuvenated towns may be termed *epifunctional* towns. We may look to hydro-electric power to rejuvenate a number of inactive towns in the near future. The effects of aerial communication are not yet apparent, but the rejuvenation of a few arrival and departure stations may be expected.

Related Towns

It happens not infrequently that the rise of one city calls a neighboring town into greater activity, and the two become interdependent. The decline of the first may also entail the decline of the second. The most familiar example is the group Paris-Rouen-Le Havre. The group Kosseir-Thebes-Kharga is an example from antiquity. The groups of small ports which screen a city to the rear on many parts of the English coast [20] are another illustration of related towns and of their decline.

The Vulnerability of Towns

Prosperity is controlled by the great trade routes and avenues of intercourse, which in their turn are lines of easy movement. Facility for movement also means facility for invasion, and hence it is submitted that vulnerability is an inherent character of urban groups. The fortress towns themselves have merely the power of resisting offense for a longer time than their companions. Power of resistance is further decreased by the fact that few modern cities are able to exist upon supplies drawn from their immediate neighborhood. Lines of water supply are often of great length, Los Angeles

[20] H. J. Fleure: Human Geography in Western Europe (The Making of the Future), London, 1918, pp. 52–53.

being a familiar illustration; but Kalgoorlie, Western Australia, probably holds the record with a pipe line 380 miles long. So great is the vulnerability of towns, that in the warlike times of the past many European towns, then much more closely related to the rural folk than now, were forced to occupy hilltops as a measure of security.[21] Vulnerability is not only of military significance: by their nature towns are liable to be the victims of infection, either physical or psychological.

The Morphology of Towns

The aspect of the town, its architectural character, and its general layout are matters of some importance for our present scheme. This character tends to vary from region to region and may be an expression of the *genius loci*. Much that is of importance to the town planner and improver may be learned from the results of regional study such as Fleure has recently made.[22] His paper suggests that the character of the town varies regionally in the same way as the grouping of the rural folk.

It is well known that towns have an extraordinary power of growth. This appears to be due to the relation between the primary occupations and the secondary occupations of the townsfolk. The primary occupations are those directly concerned with the function of the town. The secondary occupations are those concerned with the maintainance of the well-being of the people engaged in those of primary nature. The more primary citizens there are, the more secondary in a relation something like compound interest. Moreover, there are certain profits, especially in the way of amusements, to be made out of both classes. This has to be considered if the limitations of the town growth are to be studied.

The Town

The study of the individual town lies on the border line between geography and town planning. Each town presents its own problem and has its own method of development. Some very important pieces of intensive work have been done on the individual town,[23] but few general principles are discernible. The town often shows a natural division into an area of work and an area of residence, but there is an intergrowth between the two in many examples. Where they are distinctly separated there are attempts to reduce the distance or to increase the speed of the journey for the daily ebb and flow, without additional expense to the individual. Site becomes a matter of interest; but physiographic control of city growth is usually of a negative kind, the average town site permitting indefinite lateral expansion. In a few rare examples, like New York, restriction of space has brought about

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[21] See such works as E. M. Fryer: The Hill-Towns of France, New York, 1917.

[22] H. J. Fleure: Some Types of Cities in Temperate Europe, *Geogr. Rev.*, Vol. 10, 1920, pp. 357–374.

[23] E. g., Lucien Gallois: Quelques études de villes, *Ann. de Géogr.*, Vol. 21, 1912, pp. 294–311. See also "Urban Geography: A Study of German Towns" in the Record section of this number of the *Review*.

an inordinate upward growth. Many French and Italian towns offer a sharp contrast to the sprawling tendencies of English towns and show that spaciousness and compactness are not incompatible and that restriction of area is to a certain extent desirable owing to the increased facility it gives to communication.[24] Cities like Antwerp show clearly that it is not inevitable that towns should gradually swallow up the countryside. At the same time the huddled compactness of many epifunctional towns in Europe is an undesirable survival of an obsolete necessity.

Semiurban Groups

The only region known to me which bridges the gap between country life and town life is the semiurban country of southern Belgium. The semiurban effect produced in the Mons-Courcelles-Charleroi coal field has there solved the difficulty of the " black countries " in a most satisfactory manner; but it is not of evolutionary origin. It was brought about by special legislation, in which the people themselves participated actively.[25] It shows, however, that if the example is going to be copied on an extensive scale a large amount of land will be rendered useless for fundamental agriculture. Small garden holdings may produce vegetables and fruit in plenty, but they do not produce wheat.

Rural Groups

I have dealt at some length with the subject of rural populations in a previous paper,[26] to which the reader is referred for further detailed information: a brief recapitulation with a few additions is given here. In order to appreciate the full meaning of the rural groupings and to understand the changes through which they have gone or may go in the future, it is necessary to trace their origins. I have found that among the old and established peoples social organization is the dominant factor affecting the grouping in the beginning. With the gradual progress of the race or state it gives way to some form of economic organization; and not until there is a comparatively full degree of personal freedom does the grouping become a suitable adaptation to geographic surroundings. I now believe that further change in economic conditions, resulting in pressure from within, may bring about a reversion from the last and freest grouping to a kind primarily dependent upon space economy, and I will quote the Shantung Province of China as an example. The earlier stages impose a clustered grouping. With the attainment of freedom dispersions may result, if the geographic conditions be favorable, and ultimately space economy may cause reversion to a clustered grouping. I refer to community systems as economic organizations and to the villa and the manorial systems or other feudal systems, as social.

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[24] Town Housing, *London Times Literary Suppl.*, May 21, 1920, pp. 309–310.

[25] R. C. K. Ensor: Belgium (Home University Library), New York, 1915, pp. 196–203.

[26] M. Aurousseau: The Arrangement of Rural Populations, *Geogr. Rev.*, Vol. 10, 1920, pp. 223–240. See also "The Arrangement of Rural Population in Belgium" in the Record section of this number of the *Review*.

Tribal and clan systems are likewise social in their nature, and so is segregation for defense. The Russian mir is an economic group, for the Russian peasant of the steppes and forests was a serf socially before the war—whatever he may be now—in spite of his local agrarian freedom. Thus in England and France (though not universally) the following was the course of events:

Manor or villa⟹*Village community*⟹*Geographical grouping*

We know little of what preceded the feudal organization. In the newer lands the occupation is generally appropriate to the conditions, though defense may cause temporary clustering; and in the early settlement of the United States democratic ideals caused the foundation of village communities. The transitions may have been enforced by legislation or may have been voluntary movements. At the present time all three stages are to be seen in different countries, so that the adjustment to geographical conditions is far from complete.

The groups themselves form a series somewhat like the population series of an earlier section. The extremes here may be fairly clear-cut, but the intermediate stages are also comparatively common. The variation is along the line:

Cluster⟹*Partial agglomeration*⟹*Incomplete dissemination*⟹*Dispersion*

The adjustment to geographical surroundings may cause the tendency of the primitive cluster towards dispersion to stop at any point along the line; in other words, it is not always possible to achieve dispersion, as numerous geographical factors do not permit of its development. The principal kinds of groupings have been described in my earlier paper. The following additions are necessary.

Additional Forms of Grouping

1. Agglomerations. A. *Linear clusters.* In the early settlement of parts of New England the need for defense caused segregation into villages. The villages were placed close to the banks of streams, with a main street parallel to the stream. Houses lined the main street, and the farm lots stretched back from the houses in the form of long, narrow strips. This form of holding facilitated plowing; and, although the need for defensive organization has now passed, the farms of ribbon form are still to be seen in many places. The neighborhood of Hatfield, Mass., in the Connecticut Valley, where onions are cultivated, is an example. The St. Lawrence littoral below Quebec is another. The strips may be 200 yards wide and a mile long.

B. *Transplanted villages.* A sudden change in culture, leading sometimes to a modification of surroundings by man, causes the removal of villages from the old sites to new and more suitable ones. My examples are all from early, perhaps Neolithic, communities. The early occupation of Salisbury Plain (England), was in the form of defensive clusters.

placed on hilltops overlooking the valleys. These were transplanted to the sites of the present valley villages, probably as soon as the clearing of the valley forests became possible. A similar change took place in pre-dynastic Egypt, where the villages were at first confined to the higher ground of the valley sides. When it became possible to till the alluvial ground satisfactorily the villages were transferred to the flood plain. The Alpine lake dwellings of Neolithic Europe underwent a similar transplantation, particularly in parts of Piedmont.[27] The cliff dwellings of the Pueblo Indians also appear to have been forsaken for the present village sites on the tops of the mesas, if the existing folk are the descendants of the cliff dwellers.[28]

C. *Spring line villages.* In my former paper I distinguished a group of marginal girdle villages. As this term links a definite form of occurrence with a definite type of calcareous formation and allows of the prediction of its development elsewhere, the term is a desirable one. For the common and well-known strings of villages occurring on the spring line between water-bearing and non-water-bearing formations regardless of the presence of widespread calcareous formations, the current designation of spring line villages should be retained to indicate the more general type of control. Ogilvie records this type in Macedonia.[29]

2. Disseminations. A. *Hilltop dispersion.* In parts of Maine, where dispersion has developed, houses are sited on the hilltops, thus avoiding the coldness and night fog of the valleys. This indicates an additional controlling factor in rural grouping.

B. *Dispersions of different density.* It appears to be necessary to regard dispersions of wide interval as different forms from the denser types. The widely scattered farms of the wheatlands of the Canadian prairies are not under precisely the same geographic influence as the more closely disposed farms of the cornlands of Ohio and Indiana, and these again differ from the closely packed farmhouses of regions of intense culture like Flanders.

So far we have dealt only with sedentary rural groups. These are the normal types in regions responsive to man's agricultural efforts (Dr. Fleure's "regions of increment" and "regions of effort"). In many mountainous regions ("regions of difficulty") semi-mobile groups are found, as in the Alpine valleys of Europe, where permanent sets of dwellings are constructed for occupation at different times of the year. On the borders of the hot deserts similar groups are found, occupying movable structures, as in Algeria. In "regions of wandering" all groups are mobile (nomadic), and the dwelling is always portable.[30] We have therefore another rural series: Sedentary, Semi-mobile, Mobile.

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[27] See J. L. Myres: The Dawn of History (Home University Library), New York, 1911.

[28] For an account of the Pueblo Indians and the cliff dwellings see Handbook of American Indians North of Mexico, 2 vols., *Bur. of Amer. Ethnology Bull.* 30, Smithsonian Instn., Washington, D. C., 1907 and 1910.

[29] A. G. Ogilvie: Physiography and Settlements in Southern Macedonia, *Geogr. Rev.*, Vol. 11, 1921, pp. 172–197.

[30] For a highly developed type (the Kirghiz) see Ellsworth Huntington: The Pulse of Asia, Boston, 1907. pp. 106–132.

The main factors underlying the grouping of rural peoples are now capable of enumeration. They are: social organization; economic organization; the limits of possible pursuits in each region; the ground-water, rainfall, and surface-water conditions; the quality of the soil; the minimum size of holdings in each area; local weather conditions; local topographic conditions; and space economy.

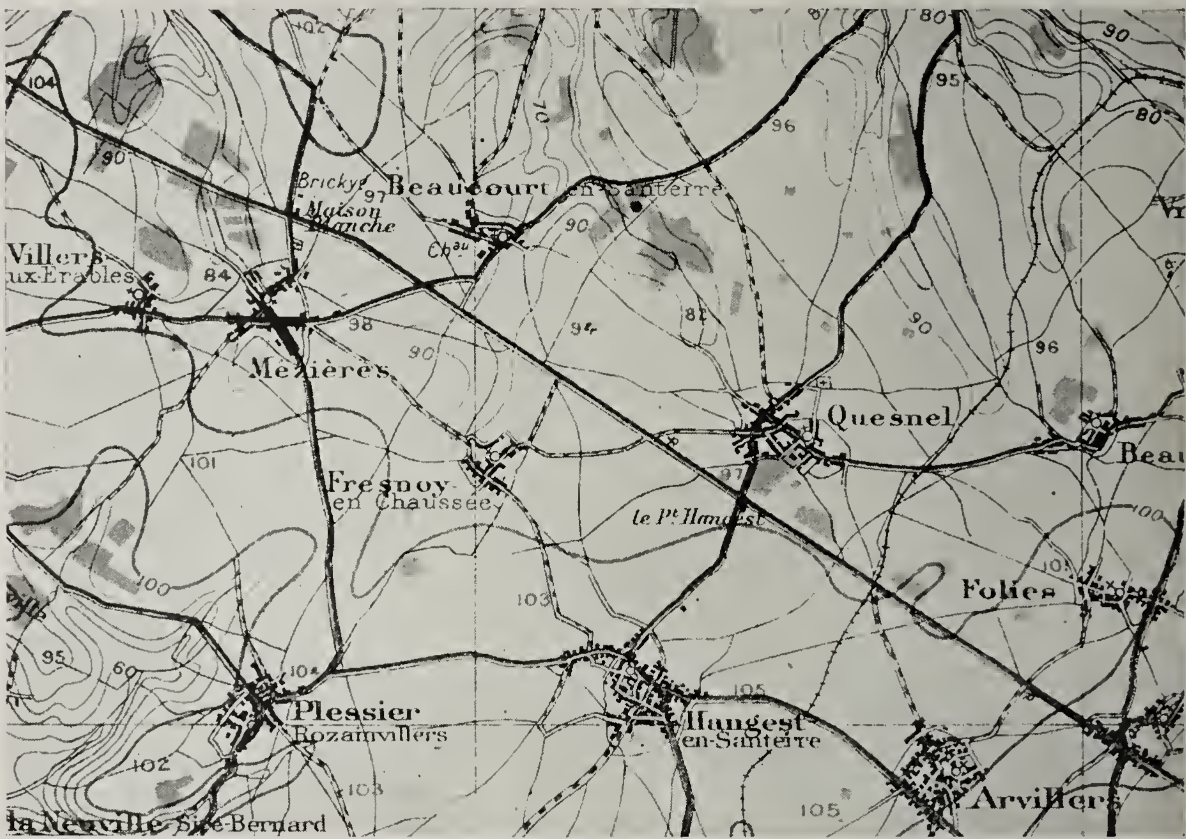

FIG. 1—A type of agglomeration, lime-land (*wet point*) villages southeast of Amiens. This and Figures 2, 3, and 4 are reproduced from the British General Staff map of Northwestern Europe. Scale 1:100,000. (Amiens sheet.)

The Significance of Social Organization and Land-tenure Systems

Early social organization is of widespread and lasting influence. Morgan, in studying the house types of the American Indians, based his whole scheme upon social organization,[31] and, generally, the more primitive the community the more powerful is the influence. It affects later systems mainly by exerting some control upon the system of land tenure, and many usages in Europe are traceable to old social organizations,[32] such as the mark system and the manorial system. Fustel de Coulanges [33] does not admit the existence of the mark system and criticizes its German proponents scathingly; but Stubbs and Ashley (see my previous paper) consider that it existed in some form in many parts of early Europe. For the latter sys-

[31] L. H. Morgan: Houses and House-Life of the American Aborigines (Contributions to North American Ethnology, Vol. 4), Washington, D. C., 1881.

[32] William Stubbs: The Constitutional History of England, 2 vols., 6th edit., Oxford, 1903, Ch. 3.

[33] N. D. Fustel de Coulanges: The Origin of Property in Land (translated by Margaret Ashley), 2nd edit., London, 1892.

tems the reader is referred to the authorities quoted in my previous paper, and to the articles on "Village Communities" and "Villenage," by Sir Paul Vinogradoff, in the Encyclopaedia Britannica. The influence of old usages in America has been very carefully investigated by Fiske.[34] If any transitions are to be effected in rural grouping, in the development of our lands, land tenure is likely to be one of the most difficult obstacles in the way, titles

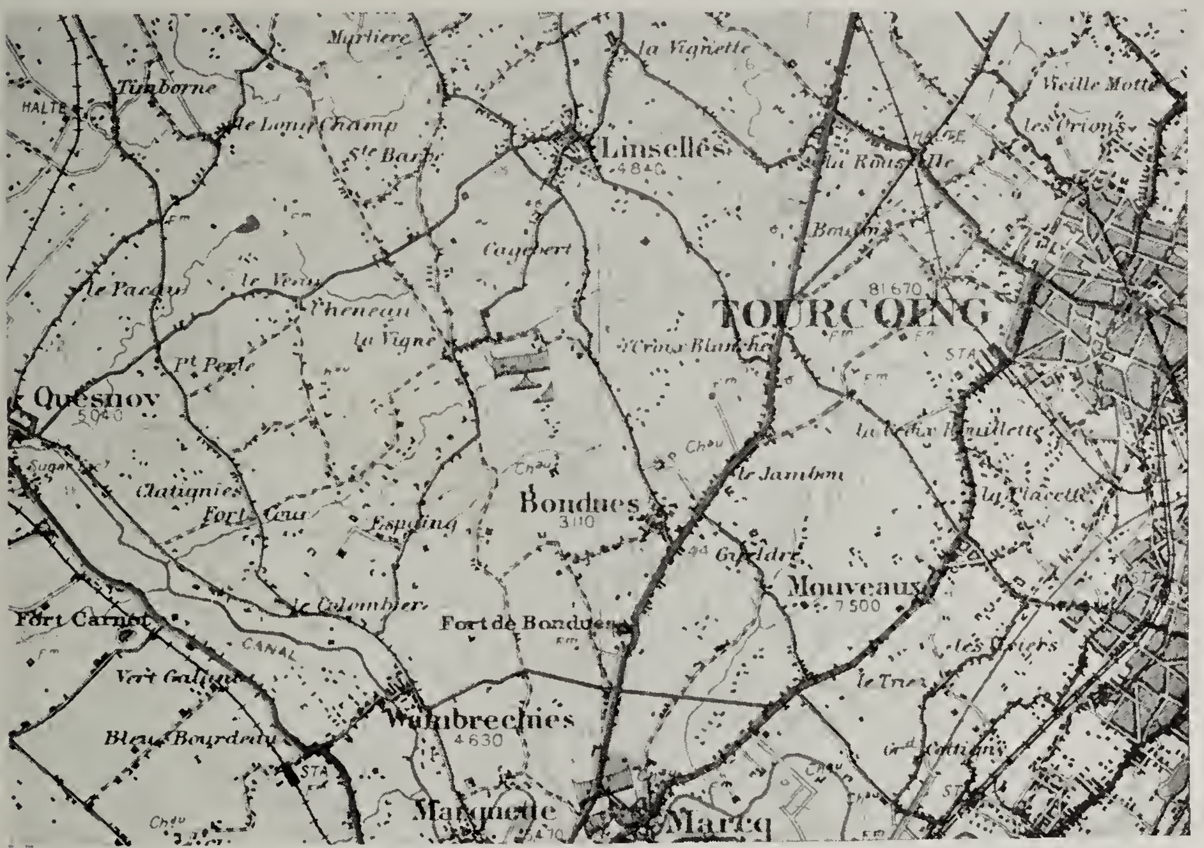

FIG. 2—An illustration of complete dissemination; north of Lille. (Tournai sheet.)

having their roots in the distant past. More comparative studies of land tenure are needed.[35] The whole question of further subdivision depends upon it.

Natural Regions

There seems to be no agreement at the present time on the subject of natural regions. Numerous descriptions exist dealing with regions obviously of quite different status, but all pass under the same name. Some writers hesitate to delimit the regions, while others assert that they are not capable of delimitation. Others still do not hesitate to divide large tracts of country into regions on various bases. I shall here review some of the more important examples, in an attempt to effect a measure of co-ordination. From a study of numerous papers dealing with the subject I believe that, for the present purpose, there are four kinds of natural regions mutually related by subdivision or combination. The delimitation of the region becomes easier as

[34] John Fiske: American Political Ideas, Boston and New York, 1911; and in other writings.

[35] Such as "Systems of Land Tenure in Various Countries" (Cobden Club Essays), new edit., London, 1881.

its size diminishes, and an ultimate delimitation of the larger regions will only be possible when our knowledge of the smaller types is more fully established. Jefferson has questioned the possibility of assigning boundaries to natural regions, on the grounds that geographical separations are never *lines* (Jefferson, *loc. cit.*); but this does not render impracticable the delimitation of natural regions if we remember that the boundaries of delimitation are *zonal* in character, while only boundaries of demarcation are lines. Fawcett's study of frontiers is applicable to many other aspects of geography besides the immediate one.[36] The four kinds of regions which I wish to distinguish are: world regions, climatic regions, physiographic provinces, and natural districts. They are listed in descending order of size, and the

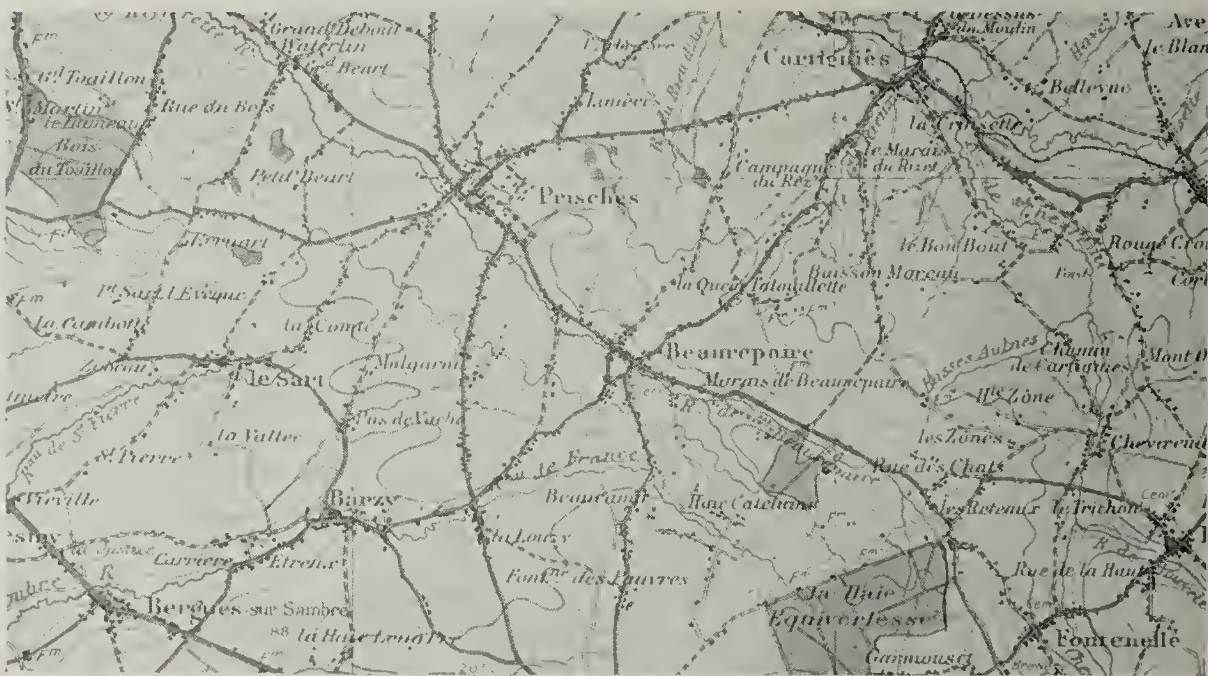

FIG. 3—An illustration of linear dissemination; southwest of Avesnes. (Valenciennes sheet.) Scale reduced to 1:130,000.

dominant element making for unity of aspect and influence becomes of wider and wider distribution in ascending the scale, the region of larger size becoming more and more heterogeneous in character with respect to the elements of restricted range and less capable of precise demarcation though not necessarily of fairly sharp delimitation. Fenneman in dealing with physiographic divisions has already proposed a nomenclature on the order of the above for regions of different status.[37] The dominant influences in these four classes of regions are, respectively, position, climate, configuration, and geology. It is not assumed that any of them acts alone, and each connotes a number of subsidiary influences. All are operative in every region, regardless of status, but to a degree that makes one of them a dominant influence.

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[36] C. B. Fawcett: Frontiers: A Study in Political Geography, Oxford, 1918.

[37] N. M. Fenneman: Physiographic Divisions of the United States, *Annals Assoc. Amer. Geogrs.*, Vol. 6, 1916, pp. 19–98.

World Regions

The concept of world regions has been put forward by Mackinder.[38] The world regions are the World Island and its subdivisions into Heartland and Coastlands, the satellites of the World Island, and the World Ring. The influence of these regions is more apparent when the course of history is followed, than it is from a mere material survey of the world. That they are of real influence cannot be doubted, nor can the fact that they place definite limits to our activities and distribution. Mackinder has delimited some of the boundaries of the subdivisions of the World Island with considerable precision, and we may hope for a still more exact delimitation.

Fig. 4—A type of agglomeration; *spring-line* villages south of Rheims. (Rheims sheet.) Scale reduced to 1:130,000.

Climatic Regions

A subdivision of the surface of the globe into regions on the basis of rainfall, temperature, elevation, and relation of the land to the sea, with other contributing factors, has been made by Herbertson and by Unstead and Taylor. The first-named has published his results in the form of papers and has later incorporated them into his textbooks. The latter authors have announced their results in textbooks.[39] There is a general agreement between the maps of both authorities, the points of difference being concerned mainly with the question of delimitation. The accord as to the general

[38] *Op. cit.*: footnote 6. See the discussion by C. R. Dryer: Mackinder's 'World Island' and Its American "Satellite," *Geogr. Rev.*, Vol. 9, 1920, pp. 205–207.

And see also F. J. Teggart: Geography as an Aid to Statecraft: An Appreciation of Mackinder's "Democratic Ideals and Reality," *ibid.*, Vol. 8, 1919, pp. 227–242.

[39] A. J. Herbertson: The Major Natural Regions: An Essay in Systematic Geography, *Geogr. Journ.*, Vol. 25, 1905, pp. 300–312; *idem:* The Higher Units, A Geographical Essay, *Scientia*, Vol. 14, 1913, pp. 199–212; J. F. Unstead and E. G. R. Taylor: General and Regional Geography for Students, 1st edit., London, 1910. See also other textbooks by the same authors.

character of the regions is sufficient to justify the belief that the subdivision is real and natural, in spite of the opposition displayed towards Herbertson's scheme when his first paper appeared. Griffith Taylor has put Herbertson's principles into application, having divided Australia into rainfall regions, on the bases of the amount of rain, the character of its fall, and relation to the sea.[40] Owing to the general low relief of Australia, elevation sinks to a place of minor importance. The regions do not accord with the details of Herbertson's classification but correspond well with his scheme. The subdivisions are eminently satisfactory; and Taylor, recognizing that precise delimitation is not yet possible, has indicated the boundaries by arbitrary straight lines. Our belief in climatic regions appears to be justified.

Physiographic Provinces

Fenneman (*loc. cit.*) has undertaken the subdivision of the United States into regions on a physiographic basis; material, structure, process, stage, etc., being the criteria employed. The results are indicated on a map. The resulting regions are for the most part of large size. I would class with this study the similar work of Cvijić, Lemoine, and Blanchard.

Cvijić[41] has subdivided the Balkan Peninsula on the basis of the human opportunity of union and penetration or the opposite, inhibitory effect of isolation and separation. These factors, in the regions considered, depend ultimately upon configuration. He distinguishes two groups of regions; the first an Aegean region, which is divisible into two subregions; the second a continental block, divisible into three regions, which in their turn fall into two, four, and six subdivisions respectively. Some of these regions are very well defined indeed, and the results have been interpreted on a map by the *Geographical Review.* The effects of relief appear to be dominant throughout; but what is important for my purpose is that the two groups appear to be separated by a climatic boundary.

Lemoine studied the department of Gard, France.[42] He divided his area into three principal regions on the basis of configuration and subdivided one of them into two geological regions. The influence of climate is never absent. Lemoine gives a geological map of the area but makes no delimitation of his regions upon it, indicating their location merely by lettering.

Blanchard has given us two important studies of this kind. He treats Flanders[43] as a "natural" region. The unity of aspect of Flanders, I know from personal experience, is purely physiographic. Further subdivision is possible, on geological grounds, and this Blanchard clearly shows, noting the grades of difference between East and West Flanders and between the dunes and "pannes" of the coastal strip. The moëres are another sub-

[40] Griffith Taylor: The Australian Environment (Especially as Controlled by Rainfall), *Commonwealth of Australia Advisory Council of Science and Industry Memoir No. 1*, Melbourne, 1918.

[41] Jovan Cvijić: La Péninsule Balkanique: Géographie Humaine, Paris, 1918; The Natural Regions of the Balkan Peninsula (after Cvijić), *Geogr. Rev.*, Vol. 9, 1920, pp. 199–204.

[42] Paul Lemoine: Les régions naturelles du département du Gard, *La Géographie*, Vol. 27, 1913, pp. 197–202.

[43] Raoul Blanchard: La Flandre, Paris, 1906; and Flanders, *Geogr. Rev.*, Vol. 4, 1917, pp. 417–433.

region. The separation of Flanders from the regions to the north is partly climatic. On the southwest there is a sharp geological and physiographic boundary. On the south the boundary is physiographic and not so well defined.

Blanchard's treatment of the French Alps is one of the most attractive regional studies of the kind yet published.[44] At the outset he draws attention to a well-marked climatic boundary which transgresses the physiographic lines, separates his regions into two groups, and modifies otherwise similar regions. Relief being here highly accentuated, the size of the regions determined by configuration is correspondingly diminished. The regions he distinguishes are prolonged around the Alpine curve past the Lakes of Geneva and Constance. Blanchard delimits his regions clearly on the map and provides a certain amount of statistical information, which indicates that the density of population varies markedly from region to region.

Natural Districts

These are the smallest of the natural regional subdivisions and are the most important for our present purpose. Lucien Gallois has concerned himself largely with them and has found them to correspond broadly with the old *noms de pays* of France. For the most part they are small regions with a marked individuality, owing primarily to the uniformity of their geological foundation.[45] Gallois, however, held reservations upon their capacity for satisfactory delimitation.

Locussol has treated the Velay district in the same way.[46] He takes geology as the basis of his description of the country and finds it divisible naturally into a number of *petits pays*, which show recurrent types, which he unifies into the basaltic, phonolitic, granitic, etc., regions. All are unified on physiographic grounds, the plateau being the form which exerts the broad influence in the country. The paper is illustrated by geological sections, but the regions are not mapped. This study is of further interest in its anticipation of the synthetic method proposed by Unstead, which will be mentioned subsequently.

Leriche treats Belgium in exactly the same way, even to the extent of identifying the *noms de pays* with the natural districts. He states "les limites de ces régions naturelles . . . correspondent aux limites des formations géologiques et . . . ces régions tiennent leur caractères physiques de la nature et de l'allure des couches qui composent leur sous-sol."[47] A knowledge of Belgium shows that these small geological regions may be grouped easily into larger physiographic provinces which extend beyond

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[44] *Idem:* The Natural Regions of the French Alps, *Geogr. Rev.*, Vol. 11, 1921, pp. 31–49.

[45] Lucien Gallois: Régions naturelles et noms de pays: Étude sur la région parisienne, Paris, 1908; *idem:* Les noms de pays, *Ann. de Géogr.*, Vol. 18, 1909, pp. 1–12.

[46] Eugène Locussol: Les régions naturelles de Velay, *Ann. de Géogr.*, Vol. 17, 1908, pp. 105–127.

[47] Maurice Leriche: Les régions naturelles de la Belgique, *Rev. de l'Université de Bruxelles*, Vol. 19, 1913–14, pp. 175–217.

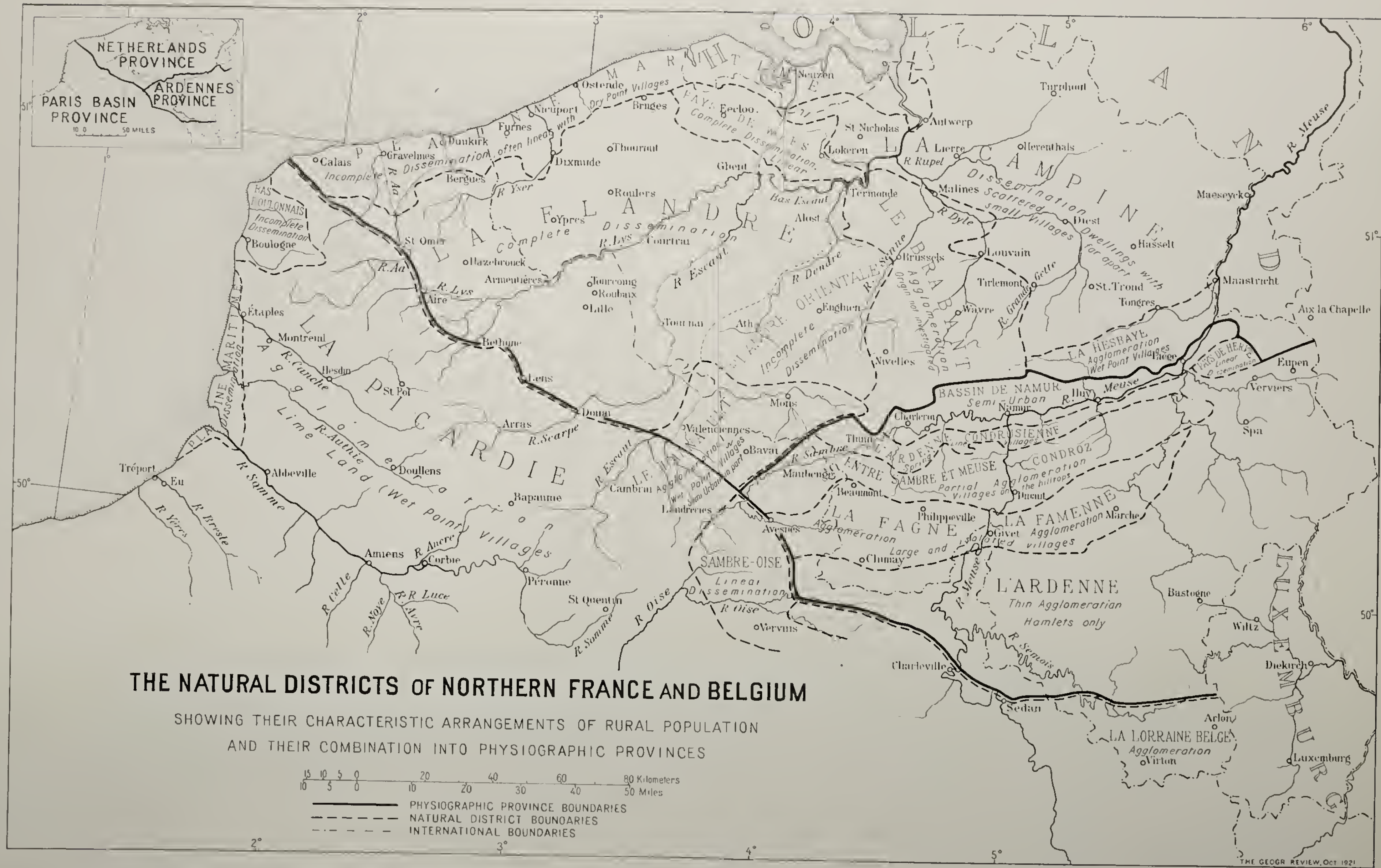

FIG. 5—Map showing the natural districts of northern France and Belgium with the characteristic arrangements of rural population and the relation to physiographic provinces (identified by name in inset map.) Scale approximately 1:2,100,000.

the confines of Belgium. Leriche's own regions of course do not stop at the Belgian frontier.

It is now fairly evident that the term "natural region" represents a different idea to different men. The ideas harmonize well with the degrees of status here proposed for natural subdivisions of the land. It is not actually claimed that x natural districts = 1 physiographic province and that y physiographic provinces = 1 climatic region. The argument is that the four classes of regions proposed are of markedly *different status* and that the smallest units are capable of being grouped into larger assemblies, which will enable a more correct assessment of the larger units to be made. It does not necessarily follow that a group of the smaller units would correspond exactly to the delimitation of the higher unit, but it would be expected to correspond fairly closely with it. In grouping natural districts into physiographic provinces a close correspondence may be expected; but the union of the latter into larger groups need not necessarily correspond very closely to the limits of the climatic region. The higher the region the more zonal will be the character of the boundary, and there may be some transgression of physiographic by climatic boundary zones. The synthetic method, however, should help materially in the more exact delimination of the higher units. This is the method proposed by Unstead.[48]

It will be noted that the authorities I have quoted have not attempted to delimit natural districts. I do not think that this is any indication that these districts are not capable of delimitation, if we keep in mind the zonal character of the boundaries. When once we are able to indicate the broad areas on our maps, careful geographical survey should serve to narrow the tentative zones considerably, and the ultimate *lines* of demarcation should agree well with the facts.

Human Regions

The regions which Fleure has recognized[49] under this heading have great significance in any study of population. Free from the complication of considering innumerable factors like those involved in the delimitation of the previous regions, these broad generalizations indicate clearly the fundamental relations of man to the earth. Their connection with the natural regions is not yet evident, but the gradual completion of the regional map will probably show close correspondence between the two types. I propose to add another type to Fleure's list, the regions of strife, to which I made allusion in my former paper.

Regions of Strife

These regions, by reason of their situation, are the traditional areas of epoch-making conflict. They are either lands of easy movement or command

[48] J. F. Unstead: A Synthetic Method of Determining Geographical Regions, *Geogr. Journ.*, Vol. 48, 1916, pp. 230–249.

[49] H. J. Fleure: Human Regions, *Scottish Geogr. Mag.*, Vol. 35, 1919, pp. 94–105.

lines of comparatively easy movement; and they lie between regions of diverse character which place things of general need or desire either under rival control, often of unequal power, or between peoples of incompatible racial and national aspirations. Battles have been fought all over Europe, but many of them have been the results of deep penetration after one party has gained command of a region of strife. Ordinarily the regions of strife are the theaters of decisive events. The Latin-Teuton boundary zone of western Europe, particularly the Netherlands; the Slav-Teuton boundary zone of eastern Europe; the outer flanks of the Carpathian-Balkan arc; Piedmont and Istria; Macedonia and the Hellespontine region; the lowlands of Palestine; the border of the grasslands on the upper Nile; upper Mesopotamia; the zone between the Indus and the mountains to the northwest; and Manchuria—these are the more prominent zones of strife.

Application

These considerations have taken us a long way from the expansion ratio. We may now review the position. In the first place a rural population based on agricultural and pastoral pursuits may be accepted as a fundamental element in world development. Therefore the first attempt at the evaluation of the ratio must be based on the rural population. It is necessary to find out how many farms each natural district will maintain at its utmost occupation. To this there is a limit for each district. The ultimate limit is reached when we have that state of subdivision which just enables the occupant to support himself and his family by his efforts. This would leave no surplus of production, and no urban population would be possible. The limit we require is that state of subdivision which enables each holder to live at a standard comparable to that of the present. Secondly, there is a limit to the number of sites either for individual dwellings or for groups of dwellings in each district. This may be imposed by geographical conditions or may be deduced from space economy by regarding the sites as the nodes of a network. The latter case is applicable where conditions, particularly of ground water, impose no restrictions on the choice of sites. This limit may also be obtained if the appropriate grouping be already in existence; if it is not, allowance must be made for its ultimate development. The basic consideration is the size of the holding permissible to the area, and the change to be brought about will depend upon the system of land tenure.

In order to have some quantitative guidance it is necessary to select a few districts as standards of reference. Flanders appears to me to be a district with a ratio already approaching unity. Shantung is an example of what is to be avoided. According to generally accepted figures for the census of 1910 the population of the province is about 500 per square mile;[50] but, when allowance is made for the extensive mountainous area, the population

[50] W. W. Rockhill: The 1910 Census of the Population of China, *Bull. Amer. Geogr. Soc.*, Vol. 44, 1912, pp. 668-673.

of the lowlands (part of which is uninhabitable salt desert) must be of excessive density. Individual instances where the land is occupied at the rate of 3,000 persons per square mile are given by King.[51] Moreover, apart from standards of this kind, as natural districts become known they will probably show recurrent types, just as some climatic regions have their homoclimes. The information gained from one region may be applicable to others. Caution is needed in dealing with regions which are very much alike, however; I have shown elsewhere that two geographically comparable regions may be developed by man along very dissimilar lines,[52] the difference in the example given—dealing with chalk lands—being due mainly to original forestation and to the relations to surrounding districts. Were this scheme applied to one small country (say Belgium) where the natural districts are well defined and the grouping of population shows clear-cut variation from district to district, we should have a valuable piece of quantitative knowledge on which reliable estimates could be based. It is not possible for one man to carry out such work, the co-operation of economists and agriculturists being required; nor could it be done very quickly; but some investigation of the kind must be undertaken to enable us to realize the state of affairs. It involves the survey recommended by Mill and Dickson, and it is the best method of stock-taking advocated by the latter. The regional survey movement in Britain of which Patrick Geddes has been the leading spirit is a step in this direction.[53]

If we ascertain the ultimate limits of expansion of our rural peoples in this way, we also acquire data bearing upon the ultimate surplus of food supply. This enables us to deduce what proportion of urban folk may eventually be capable of development. It is a far remove from this to the control of city growth, but it is not a stretch of imagination to say that both the number and the size of cities must have some maximum limit. This limit is intimately related to the limit of food supply. There is another limitation which may assist in arriving at more definite conclusions, and it is to be deduced from the fact that the number of possible positions for cities is a comparatively small one. A study of Blanchard's map of the French Alps[54] will probably convince one that no more towns of importance are likely to arise in the region. The nodal points are already occupied. A military staff officer in studying a natural district would very likely have little difficulty in marking on his map the positions and number of critically nodal points.

If asked how one should set to work in order to ascertain the expansion ratio of a country I would submit the following scheme as a feasible one. A geographical survey of the country should first be undertaken, in order

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[51] F. H. King: Farmers of Forty Centuries, or Permanent Agriculture in China, Korea and Japan, Madison, Wis., 1911.

[52] M. Aurousseau: A Contrast in Chalk-Lands, *Scottish Geogr. Mag.*, Vol. 36, 1920, pp. 158–161.

[53] The progress of the regional survey movement has been followed in the *Geographical Teacher*. Among other papers see "A Conference on Regional Surveys," *Geogr. Teacher*, Vol. 8, 1915–16, pp. 89–96 and 164–172.

[54] *Geogr. Rev.*, Vol. 11, 1921, p. 33.

to delimit the natural districts on geological grounds. It is not my contention that every outcrop should be mapped as a separate geological district. Indeed, for this reason, Fèvre and Hauser reject geological subdivision in their treatment of France from the regional standpoint, on the grounds that it is an "atomisme géographique."[55] Leriche and Blanchard have set an admirable standard, in their treatment of Flanders, for the degree of geological unity to be aimed at. The boundaries of the natural districts should be mapped, and each district should then be treated as a unit, in the following manner: the grouping of the rural folk should be studied in detail, and the local controls established. It is necessary to determine whether or not the grouping is a full geographical expression and, if not, what form of change is likely to operate. All dwelling sites and potential dwelling sites should be mapped. The hydrology of the district therefore requires thorough study in order to determine the potential and actual "water points." The land under forests and farms should be mapped, and the land capable of being farmed is also to be marked out. Land under urban occupation or absorbed in railways and roads must be indicated. Field study of the size and nature of the farms, and of possible changes in the kind of agricultural or pastoral pursuits must be made. It is also necessary to map the critically nodal points of the district, as potential urban positions, and to determine from field study whether or not the existing towns and cities of the district are likely to experience decline or rejuvenation. With this information, the survey may now turn to the statistical records of the region and apply them in an office study. The smallest administrative subdivisions must be recognized as the basis of treatment here; but they are usually much smaller than the natural district (parishes and communes of Europe, for example) and can be grouped so as to correspond closely enough with the natural districts. It may be necessary, however, to use statistics compiled by different authorities and on different bases; but this is unavoidable until administrative units have some semblance of correspondence with geography. The productivity of the forests needs study; and the amount of land per capita which must be maintained under forests must be determined. From the productivity of the farms the size of the average workable farm may be determined; and from this and from the surveyed information the possible extensions of farming may be deduced. Here it is necessary to make cautionary corrections for the amount of forested land the ultimate rural population will require and for the amount of pasture the ultimate number of farm animals will require. Allowing for these corrections, the ultimate capacity of the region is ascertainable, provided the field survey indicates that suitable dwelling sites, under an appropriate grouping, exist for the number of families deduced from the calculations entailed in the above work. Balancing up these factors, we have the rural expansion ratio for the natural district under consideration. The study that the geographer will have made of land tenure in the district

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[55] Joseph Fèvre and Henri Hauser: Régions et pays de France, Paris, 1909, p. 10.

will enable him to formulate any administrative measures necessary to effect desirable changes in the district. Reliable deductions, however, do not end here. Knowing the ultimate rural capacity of the district, we also have information on the possible surplus of food production; and from this may estimate the possible limits of urban growth. If it appears from the estimate that new towns are likely to arise, the nodal points of the district having been mapped, the best positions for new towns can be indicated with confidence.

The method of work may be expected to vary somewhat from district to district and must be learned largely by actual experience, just as the geological surveyor in a new area has to make an extended reconnaissance before he is able to decide on the best method of attack and treatment.

Maps

Good maps are badly needed, but three maps of a special kind seem to me desirable. The making of them calls for the establishment of geographical surveys organized in a similar way to our geological surveys. We need an "earth-material map," a power map, and a lowland map.

The Earth-Material Map

The rocks of the earth are of paramount human importance. The geologist finds it necessary to map formations which are of no use to the geographer. What we require is a type of map showing the following features: areas of deep drift soils, such as the glacial clays and the great plains of accumulation; areas of residual soils and the distributions of the rocks from which they are derived, such as granites, basalts, limestones, chalks, shales, slates, alternating strata, unconsolidated beds, etc.; hydrological information; coal and petroleum districts; locations and kinds of metalliferous and other economic deposits. These are the significant things. It is far more important for us to know that an area is an expanse of thick, flat-bedded sandstone than it is to know that it is a region of "Upper Triassic sediments."

The Lowlands Map

The ordinary orographical map accentuates the highlands, which, from the point of view of human occupation, are unimportant. Let us reverse the scheme and accentuate the lowlands and see at a glance where the great masses of men are likely to live. A small intermontane basin makes a poor showing on the ordinary map, but if the colors be reversed it stands out at once.

The Power Map

The most important factor in the distribution of mankind, apart from earth material and climate, is power and the sources of power. These

should be specially mapped, due regard being paid to sources of wood fuel, wind power, water power, coal and oil, and hydro-electric power. It is quite likely that we shall discern power boundaries and regions characterized by different power possibilities. Again, we may be forced to revert to the obsolete sources of power to some extent.

The history of power for industrial purposes falls naturally into four periods, or phases of development. The first involves the use of manual or animal power; the second that of wind, water, and wood fuel; the third that of steam and electricity, both of which are primarily dependent on coal; and the last is just emerging as the internal combustion (oil) and hydro-electric age. The transitions from one source to another involve great movements of mankind.

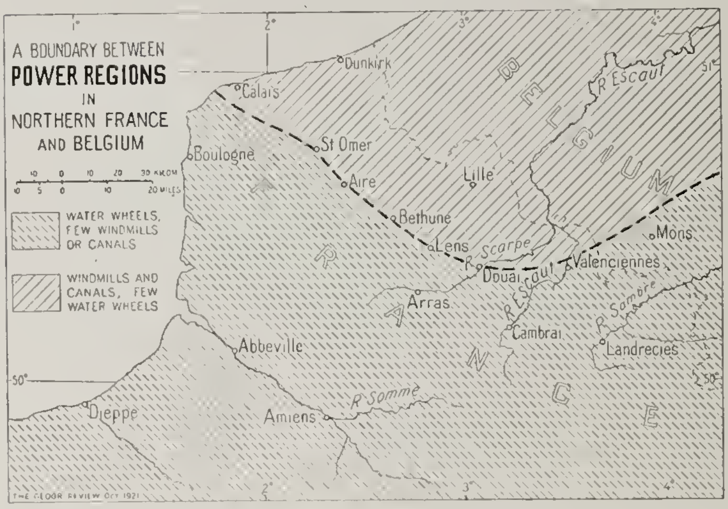

FIG. 6—An illustration of power mapping; the boundary between regions of water power and wind power in northern France and Belgium

Windmills and water mills are a relic of the second age; but, like wood fuel and manual labor, in many places and mainly owing to their cheapness, they still survive for local use or for special purposes. It is improbable that the sailing ship or the windmill will ever disappear entirely from use. Water mills, being much more reliable and constant than windmills in their work, are used in preference to the latter wherever possible.

Owing to the configuration of northern France windmills and water mills have a well marked regional distribution. In French Flanders and extending away into Belgium, Holland, and Denmark is a flat and monotonous country where the streams are sluggish and are best used as canals for barge traffic. The wind, however, gathers force as it sweeps over the flat expanses and on every tiny knoll is caught in the sails of a mill that grinds the local grain. North of the Scheldt (in France) the water mill is practically unknown. Southwest of the line St. Omer-Aire-Béthune-Douai-Valenciennes the situation is entirely different. Here we have the undulating area of the chalks, stretching away into Normandy, Picardy, and the Champagne—a region of small but swift streams draining into large and lazy rivers. The small streams are studded with water mills which work almost throughout the year, and barge traffic is confined to the lazy rivers. There are a few scattered windmills in the region, for villages exist far from the streams where the chalk expands into small plateaus. The whole region is, nevertheless, one of water mills and produces flour in plenty for local use.

The Ethical Problem

We talk a great deal about an urban exodus, but the townsman shows little inclination to take to permanent country life. Before such an exodus can take place life in the country must become as attractive, in satisfying the higher needs, as life in the towns. Town life is community life developed to a high degree, but the old community spirit has disappeared almost completely from the country, leading to what is termed in England "the problems of village life." Until some of the old spirit is again infused into the country no exodus from the city is likely to take place. Community ideas appeal to the mass of mankind, and experiments in communism have been made even in America.[56] A movement is now on foot which, if successful, should do a great deal for country life by creating community interests and providing means for their prosecution.[57]

Our concern from this point of view is more with the "country planning" suggested by Dickson. Human interest is rarely absent from the landscape in any settled country. Dwellings and villages, the construction of roads, railways, and canals, the planting or removal of forests, hedging and ditching, engineering structures and works, and the mere outlines of farms all contribute to the making of the average landscape and in time mellow into it. The results are often extremely pleasing but are sometimes quite the reverse; yet how simple is the process of making a building or an engineering structure artistic or attractive without sacrificing its efficiency or increasing its cost! The contrast between the bridges of London and Paris is an example, not without individual exceptions on both sides; but the balance is greatly in favor of Paris. A satisfactory broad effect may be produced unconsciously, as in many parts of rural England; or by conscious effort, though not necessarily directed to this end, as in rural France. Rural England is generally preferable to rural France, owing to the relatively slight interference with what is left of nature.

Flanders offers an example of extreme formality, the result of its flatness and intense agriculture. A checkerboard effect has been produced by the rectangularity of roads, hedges, and ditches and by the planting of rows of trees; while monotonous regularity results from the lopping of the lower boughs of the trees and the constant repetition of the same house type, every red cottage having its duck pond, and by the straight reaches of the canals. The untrammeled expression of nature is confined to the roadsides and ditches. Nobility has here been sacrificed for prettiness; and the lack of freedom is somewhat stifling to one accustomed to more open country. It is almost impossible to ride off the road in Flanders.

This aspect of scenery is of more than sentimental importance; as scenery is a feature capable of great modification by man, the more urgent is the

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[56] W. A. Hinds: American Communities, Oneida, N. Y., 1878.

[57] See publications of the National Community Board, Washington, D. C.; also, Dwight Sanderson: Country-life Forces Mobilizing, *Review of Reviews*, April, 1921, pp. 421–425 (an account of the activities of the National Council of Rural Social Work).

necessity that its evolution be well guided in order that the best may be made of our physiographic foundation. The argument for the influence of surroundings might be elaborated to an infinite extent.

The French geographers have made important contributions of the kind required, in studying the morphology of the house and village, which varies regionally like that of the town. These efforts, which have a bearing upon the construction of the right kinds of houses, should be extended to various climes.[58]

Information

If important results are achieved in this section of geography it is necessary that they be incorporated in the common stock of knowledge more promptly than are most technical studies, in order that the prevailing ignorance on the subject of population may be removed. Sosman has shown that the distribution of scientific information falls far behind the production of the information and has reviewed all the present means of distribution.[59]

Geographical science is in a more favorable position to achieve distribution than most other branches, owing to its general interest and appeal. Some improvement might be made, however, by more direct guidance of teaching in schools, colleges, and universities. The geographical associations are powerful enough to have a large share in planning the curriculum for instruction. If they would do their share, they might ensure a more rapid distribution of the great principles which rise readily to the surface of the sea of minor results of research. The map is another powerful means of spreading information, and I would suggest a scheme somewhat like deliberate advertising by means of lucid maps. The eye takes in a great deal of information in properly co-ordinated form from maps, especially if the central idea which the map is intended to convey be expressed also in a pithy and prominently printed sentence. The London Zoo has done much to popularize itself by its scheme of advertising, and the attractive advertisements displayed in the London underground railways are interesting in themselves. It is possible for the geographical societies to devise a scheme for the distribution of information by advertisement which would reach the adult and so keep the general public well informed in a way that is impossible if we work through schools alone. Knowledge carried from school is likely to be many years out of date where the adult is concerned. The success of the *National Geographic Magazine* assures us of a large audience desirous of receiving interesting information attractively presented and warrants an attempt being made in the way suggested. We may yet see the properly accredited poster map achieving for geography that result which all branches of science desire, the existence of a public not only provided with the correct information but also knowing the why and wherefore of the facts and therefore desirous of utilizing them.

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[58] See Paul Privat-Deschanel: L'habitation humaine dans le Sénonais, *La Géographie*, Vol. 16, 1907, pp. 209–224; Jean Brunhes: La géographie humaine, Paris, 1912, Ch. 3; Albert Demangeon: L'habitation rurale en France, *Ann. de Géogr.*, Vol. 29, 1920, pp. 352–375.

[59] R. B. Sosman: The Distribution of Scientific Information in the United States, *Journ. Washington Acad. of Sci.*, Vol. 11, 1921, pp. 69–99.

THE CYCLE OF EROSION IN A KARST REGION (AFTER CVIJIĆ)

By E. M. Sanders

The Conception of a Karst Cycle

Professor Davis has earned the gratitude of all geographers by standardizing the descriptive terms employed in explaining the various stages in the evolution of land forms in a region of normal climate where the rivers flow upon the surface of the ground. To him and to Professor Siegfried Passarge we also owe a similar development of the idea and terminology of the desert cycle where wind erosion and exportation of land waste in an arid climate combine with perennial stream action to produce a group of distinctive forms. There is no such uniformity, however, to be found in the use of

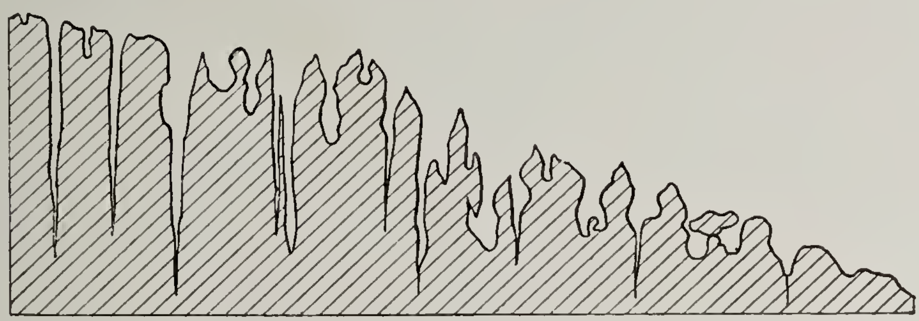

Fig. 1—Lapiez, name given to combined erosion and solution forms developed by water action in the rock fissures of limestone surfaces. From de Martonne, after "Traité de géographie physique", 1913, p. 471.

terms to describe the forms evolved in a karst region where the rivers flow underground for the most part. Though much research has been done upon the problem, the results, published in French, English, and German, have not yet been correlated. In 1918 Professor Cvijić, one of the most energetic and original of those who have studied karst topography, published a résumé of former theories on the development of subterranean drainage, supplementing them by the results of his own work and by an ordered description of the successive changes that take place in the progress of the karst cycle.[1]

The article of Professor Cvijić marks a step forward in the science of physiography; but it is far from easy reading for the average geographer since many unfamiliar terms, such as "bogaz" and "ponor," are used without either definition or explanation by synonyms. The terms are often Serbian words which convey no meaning, either by their form or derivation, to those

[1] Jovan Cvijić: Hydrographie souterraine et évolution morphologique du Karst, *Recueil des Travaux de l'Inst. de Géogr. Alpine*, Vol. 6, 1918, Grenoble, pp. 375–426. By courtesy of Professor Raoul Blanchard the *Geographical Review* has been furnished with the original blocks used in the printing of Professor Cvijić's paper. All of the illustrations are from this source except Figure 1, though Figure 11 has been re-engraved to a smaller size.

ignorant of the Serbian language. The object of the present article is to present Professor Cvijić's summing up of the whole matter, amplifying it with definitions of the terms used, and giving, where it is possible, the terms [2] used by others for the same forms. Karst is the term corresponding to the French word "causse," a word which Baring-Gould, in "The Deserts of Southern France," has made familiar to English readers. Karst topography is developed in many limestone or dolomite regions, because these rocks weather differently from others. The difference is due principally to the

Fig. 2—A lake formed on the floor of a doline or sink-hole near Belgrade.

solubility of calcium carbonate in natural waters. The first solution channels owe their pattern to the highly developed system of joints which is nearly always found in such rocks. In a region where karst topography is fully developed the water circulates almost entirely underground.

Basic Assumptions

The structure of karst regions is so varied that innumerable complications ensue. Let us, therefore, take one type associated with a structure in which

[2] The equivalent terms and examples are taken from earlier works: from Jovan Cvijić's "Das Karstphänomen" (Geogr. Abhandlungen von A. Penck, Vol. 5, No. 3), Leipzig, 1893; from Emmanuel de Martonne's "Traité de géographie physique;" and from James Geikie's "Earth Sculpture." The dimensions of the different land forms are taken from Cvijić's "La Peninsule Balkanique," Paris, 1918. The identification of "karren" and "lapiez" is taken from Eugène Renevier's "Monographie der Hautes Alpes Vaudoises" (Matériaux pour la carte geol. Suisse), p. 499. Various publications of the U. S. Geological Survey furnish examples of karst topography in the United States.

Since the above was written E. A. Martel's "Nouveau traité des eaux souterraines" (reviewed in this number of the *Geographical Review*) has appeared. The varied terms applied to karst forms are discussed on pp. 130–133.

all stages of evolution are possible: a mass of limestone of great purity and solubility, formed of strata inclined at a great angle, with few complications due to crushing, faulting, etc. The thickness of the mass is to be such that, although its base is above sea level, its surface reaches a considerable height. Let us have the mass exposed to a Mediterranean climate with so dry a summer season that only those plants exist which are fed from the roots or which can store up moisture for themselves. This provides that the limestone surface shall not have a thick protective covering of vegetation.

FIG. 3—Cultivated alluvium on the floor of a doline at Cevo, Montenegro. Note the barren and uncultivated limestone surface roundabout.

Further, let us assume that at a time immediately preceding the inauguration of the cycle of karst erosion there was a covering of impermeable strata over the limestone on which a normal system of streams had developed and that another impermeable layer exists under the base of the limestone mass.

Underground Waters in Three Hydrographic Zones

The evolution of the land forms in such a region follows step by step the evolution of the subterranean drainage. It is therefore necessary first to consider the way in which the underground waters develop their channels. Up to the appearance of the article of Professor Cvijić two divergent theories as to the circulation of underground waters held the field.[3]

One of these theories regards the subterranean waters as circulating continuously, all irregularities being explained as due to siphons[4] which

[3] E. A. Martel: Notices sur les travaux scientifiques, Paris, 1911.
[4] F. Katzer: Karst and Karsthydrographie. *Zur Kunde der Balkanhalbinsel*, 1909. Sarajevo.

force up the water, the stagnant water being regarded as a merely temporary accident. The other theory[5] holds that there is a saturation level in the limestone mass, below which all the crevices of the limestone are filled with water continuously, the only circulation that exists being the descent of the rain that passes through the porous limestone until it reaches the saturation level, after which it is stagnant. Many phenomena, such as the successive displacement of springs and the change of level and final desiccation of the temporary lakes that are found in karst regions, are difficult to explain by either of these theories; and the result of many years of observation has led Professor Cvijić to the conclusion that different conditions exist within the

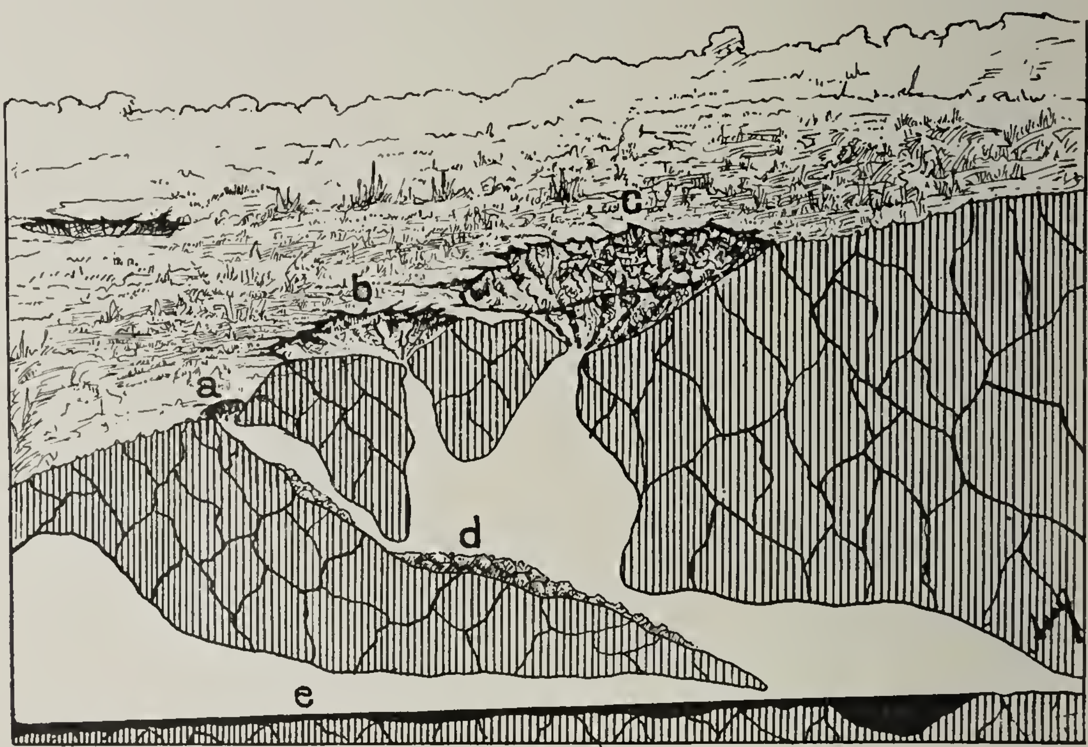

FIG. 4—Underground caves, passages, and drainage, and their connection with dolines or sink holes at the surface. Note the beginnings of waste accumulation underground and the poorly organized state of all drainage slopes. Cave of Petnjica, near Valjevo, Serbia.

limestone mass at different stages in its evolution—the conditions being sometimes favorable to one of the former theories, and sometimes to the other. He considers that in a fully established karst system there are three hydrographic zones:

(1) The zone immediately beneath the surface is composed of channels and reservoirs which transmit water in time of storm but are usually dry.

(2) The next zone is intermittently dry and wet; its caverns and channels may be flooded for considerable periods but not permanently.

(3) The lowest zone, situated immediately above the junction with the underlying impermeable strata, has permanent streams and reservoirs which are always full of water.

There are many modifications of the ideal scheme due to geologic structure

[5] A. Grund: Die Karsthydrographie. Studien aus Westbosnien (Geogr. Abhandlungen von A. Penck, Vol. 7, No. 3), Leipzig, 1903.

and other causes. Normally, the youthful stage of a karst region is marked by the development of underground drainage so imperfect as to leave a large amount of the water that falls as rain remaining on the surface of the ground, although all the cracks and crevices of the rock are filled with water. In this stage permanent lakes exist. In the next stage the subterranean system is sufficiently developed to carry off all the surface water except in times of exceptional downpour. In this stage intermittent lakes are found. In the perfectly developed system all of the surface water is carried immediately underground, and consequently no lakes exist unless the depressions of the surface are so deep that they dip below the upper level of the saturated zone.

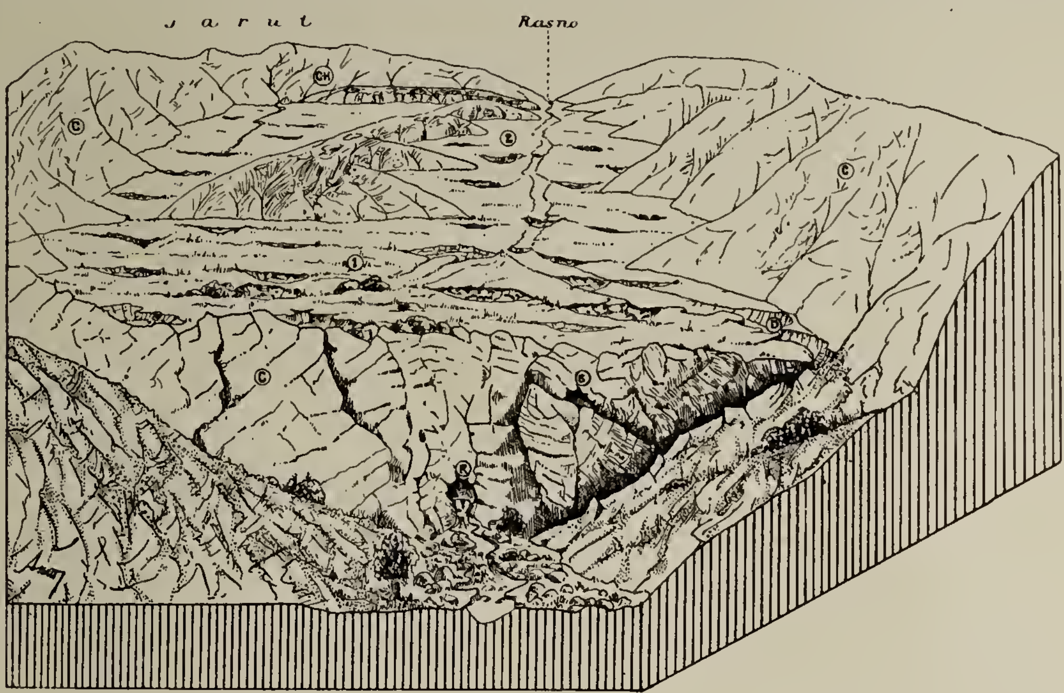

FIG. 5—Type of polje or blind valley of fluvial origin. Polje of Kostan, near Novi-Bazar. At first normal valleys were formed as in the center background and on the right where the main gorge lies now completely dry. After sub-surface changes had diverted the stream underground it issued first at (S) and now at (R) 100 meters lower. The upper part of the Rasno valley, shown in the diagram, is now a young polje, and here also the stream has been diverted underground by the development of ponors or intake openings.

FOUR STAGES IN THE EVOLUTION OF KARST TOPOGRAPHY

Contemporaneous with the development of the underground drainage is the evolution of the land forms of the surface. Four phases are distinguishable, which may be called youth, maturity, late maturity, and old age.

In youth, the surface of the land is still principally drained by the rivers which flow on the former surface of the land before the limestone subject to karsting was laid bare, or when it was at a lower level or had a better climate and denser vegetation and normal surface erosion took place. This earlier development of normal surface drainage is an important feature of Cvijić's explanation, youth being marked by a progressive loss of surface drainage. Rivers flowing above ground disappear, and in some cases the disappearance takes place in a few decades. There are reliable records of recent changes of this sort. Wherever the limestone

is exposed to the rain the ground is covered by a network of furrows eaten out of the rock by the dissolving water. Each furrow may be only a few inches wide but is from three to six feet deep. It is as if the hard rock had been deeply plowed, so thoroughly is its surface scored by these

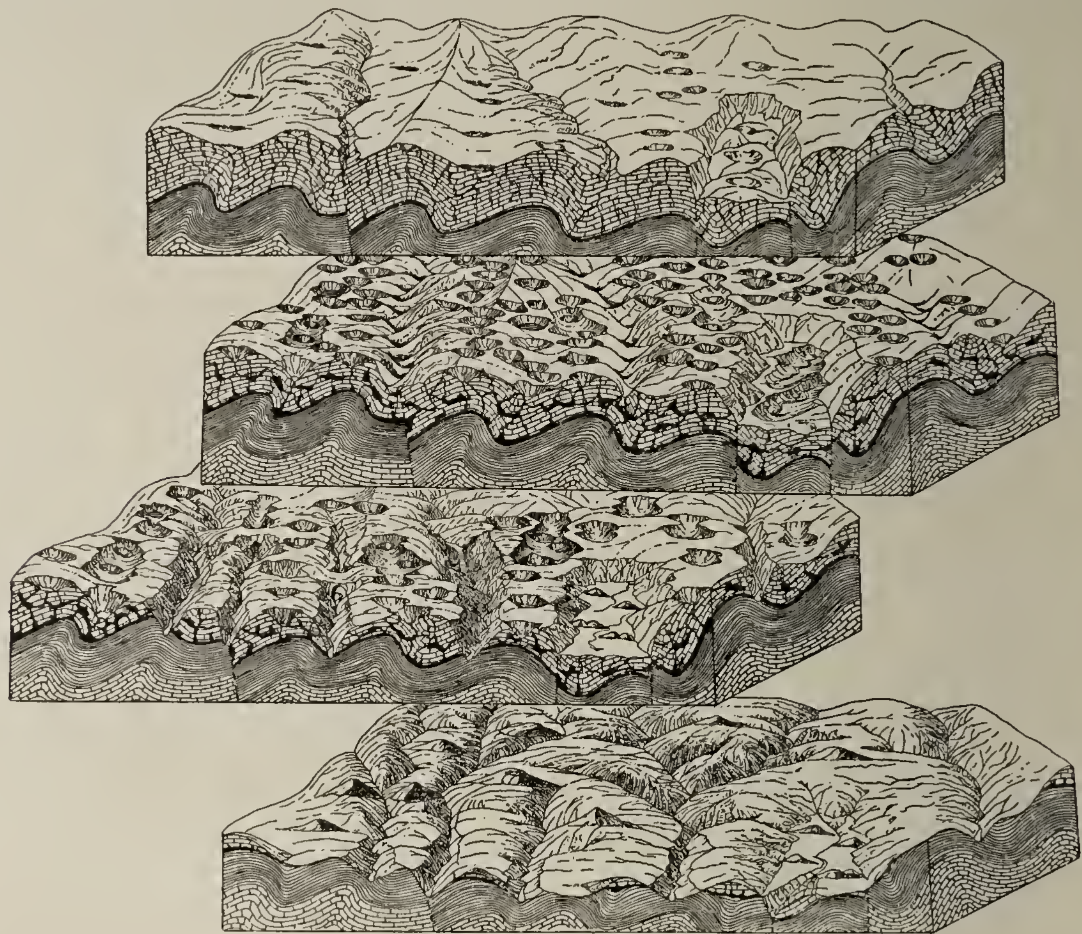

FIG. 6—Four main stages in the evolution of karst topography.

(1) The uppermost block represents a youthful stage of development. There are the beginnings of normal valley cutting in elongated depressions, called poljes, of tectonic origin. Fissures near the surface afford the means of subterranean channeling, and scattered dolines appear.

(2) The next lower block represents maturity or the strongest expression of the karsting process. There are no surface waters save where uvalas have formed by the breaking down of cave roofs. Fissures have been enlarged into caves and reservoirs and the surface valleys of youth have become completely disorganized by dolines and uvalas.

(3) Late maturity is represented by the third block from the top. Valleys are formed, either through the foundering of cave roofs along old valley axes or by the marginal development of underground courses without surface control. In this process many dolines and uvalas of an earlier stage have disappeared. Where ground-water level has been reached, valley widening has begun, and, as in the right foreground, hums appear, that is fragments of the once honeycombed limestone mass.

(4) Old age is represented by the lowermost block. Normal valleys have been cut in the impermeable rocks that form the floor of the limestone mass whose fragments occur scattered here and there in the form of hums.

furrows (Fig. 1). Such land is avoided by man and beast, for it is exceedingly difficult to traverse. There are many different terms to denote it. In the French Alps "rascles" is the term, while the German equivalent is "Schratten" and "Karren." The name adopted by Professor Cvijić is "lapiez," which is the term used in the French Jura.[6]

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[6] Martel: Nouveau traité, pp. 531–550.

Where any line of weakness, such as a fault or bedding plane or joint, allows the water to penetrate more easily, deep and narrow chasms are eaten out. These are termed "bogaz" by Cvijić. The ordinary French term is "gouffre d'absorption."

Such are the beginnings of erosion in the limestone. Little by little, however, the furrows and chasms are deepened, and underground channels are

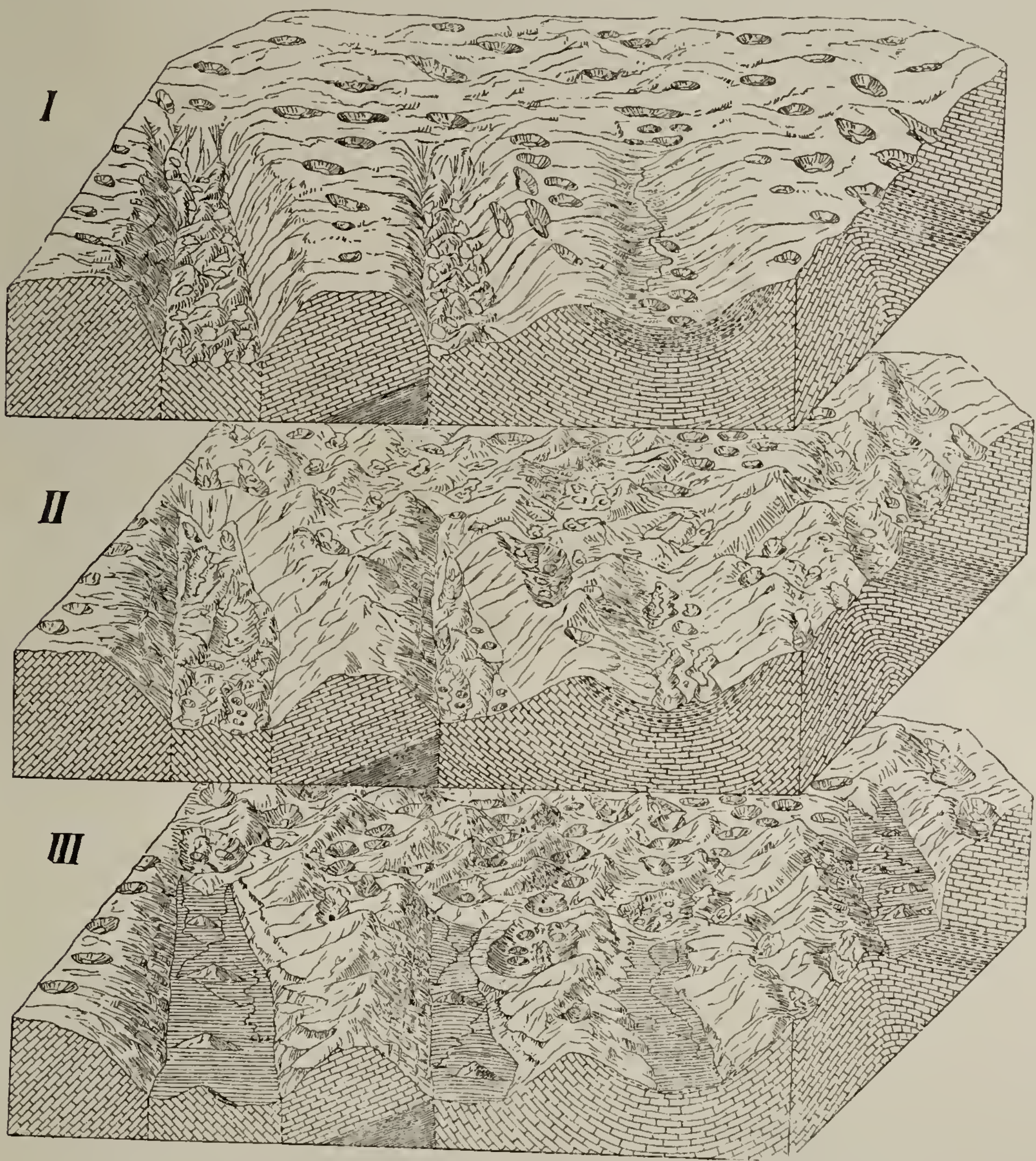

FIG. 7—To illustrate the development of poljes or major elongated depressions.
I. Structural depressions whose origins are shown on the front edge of the block. After moderate normal erosion the effects of karsting have become prominent.
II. The same region at maturity with uvalas and surface drainage in part.
III. Advanced stage of valley development with continuous surface streams and only occasional isolated hums on the valley floors.

created. Often in the course of a stream such a chasm appears, and soon the streams disappear down holes in the ground in mid-course, leaving their valleys dry either wholly or in part. A valley that is deserted by its stream in this fashion is called a "blind valley" (*vallée morte*). Figure 5 shows two such valleys. The holes down which the streams disappear have many names. Roughly they are of two classes, those that are funnel-shaped and

those that are cylindrical. The funnel-shaped depressions with a hole in the center have long been called "dolines." The French terms are "sotch" and "cloups," used in the causse region; "creux" and "emposieux," used in the Jura; and all of them correspond to the terms "sink hole," "swallet hole," "cockpit," and "light hole" of English writers. In Yucatan the common word is "cenote."[7]

The shaftlike aperture Cvijić calls "ponor." In French "avens" and "jamas" are commonly employed; but "gouffre," "abime," "puits," "pertes,"

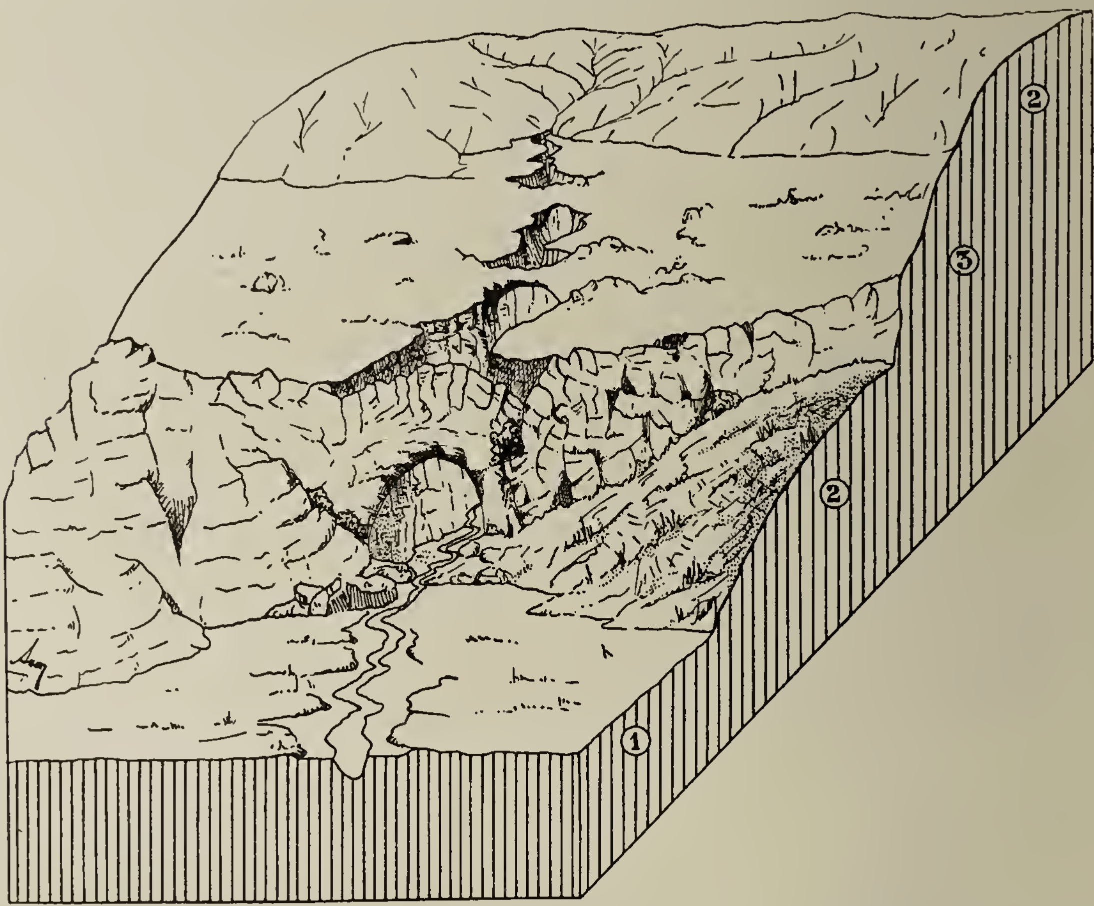

FIG. 8—Cavern transformed into a gorge. The Vratna, a branch of the Danube in eastern Serbia. 1 represents alluvium; 2, sandstone; 3, limestone.

"betoirs," "sucoirs," "igues," and "tindouls" are also used. The Belgian term is "aiguegeois." The Greek equivalent is "katavrothes," while the German term is "Kesserthaler." The latter term is also used for blind valleys.

As time goes on, the divisions between neighboring dolines are broken down; and larger depressions, called "uvalas" or "ouvalas," are created. A uvala is usually more than one kilometer in diameter; a doline may be from ten to a thousand meters in diameter. Other large depressions, at least roughly linear in form, are also found in karst regions. They are called "poljes." They may be formed by the junction of several uvalas or they may have originated as blind valleys, or, as most commonly, they may owe their origin to tectonic depression. Many other conditions or accidents may

[7] L. J. Cole: The Caverns and People of Northern Yucatan, *Bull. Amer. Geogr. Soc.*, Vol. 42, 1910, pp 321–336.

be the original cause of their development. In one way or another and with many possible combinations of conditions, structural and hydrographic, the limestone surface, riddled with ponors and dolines, disappears in places, and great flat-bottomed depressions are formed. Eventually their floors become covered with alluvium as the watercourses work down to impermeable strata or reach normal base level.

The youthful stage of karst topography is shown in Figure 6. It will be noticed that the limestone mass is traversed by innumerable fissures, but that no great caverns are as yet formed. The development of the underground system of drainage is far from complete. In the early stages of youth only one hydrographic zone is established; and not until maturity is reached

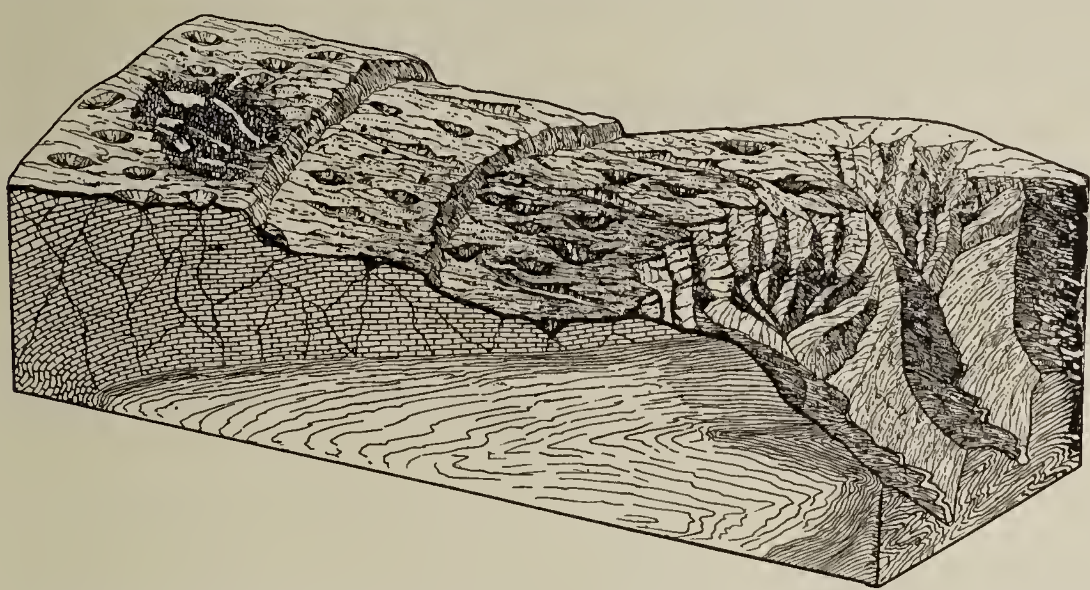

FIG. 9—A branch of the Narenta in Herzegovina, to illustrate regressive erosion in the karst, a special feature of the Dinaric lands where normal valleys in relatively insoluble rocks (right) are developed side by side with typical karst features (left) formed after an earlier period of normal erosion.

are three zones developed, although toward the end of the period of youth two zones may be distinguished—an upper zone which is flooded intermittently and a lower zone which is always completely saturated.

Examples of karst topography may be found in many parts of the United States. Among others, Tennessee, Kentucky, and Virginia have large areas where various stages of karst development may be seen.[8]

As the course of erosion proceeds, both the surface and the underground system are modified. The higher land separating the uvalas, or major depressions, is dissolved away, and many stretches of flat land are formed, surrounded by higher land which shows dolines and ponors (Fig. 6) and the irregular surface due to lapiez. The underground drainage is now fully developed, a network of caverns and channels permeating the entire mass of limestone. These channels are sufficient to carry off all the

[8] For maps illustrating karst features in the United States, and for discussions thereof, see Salisbury and Atwood: The Interpretation of Topographic Maps, *U. S. Geol. Survey Professional Paper No. 60*, 1908, Pls. 90–94 and pp. 54–55.

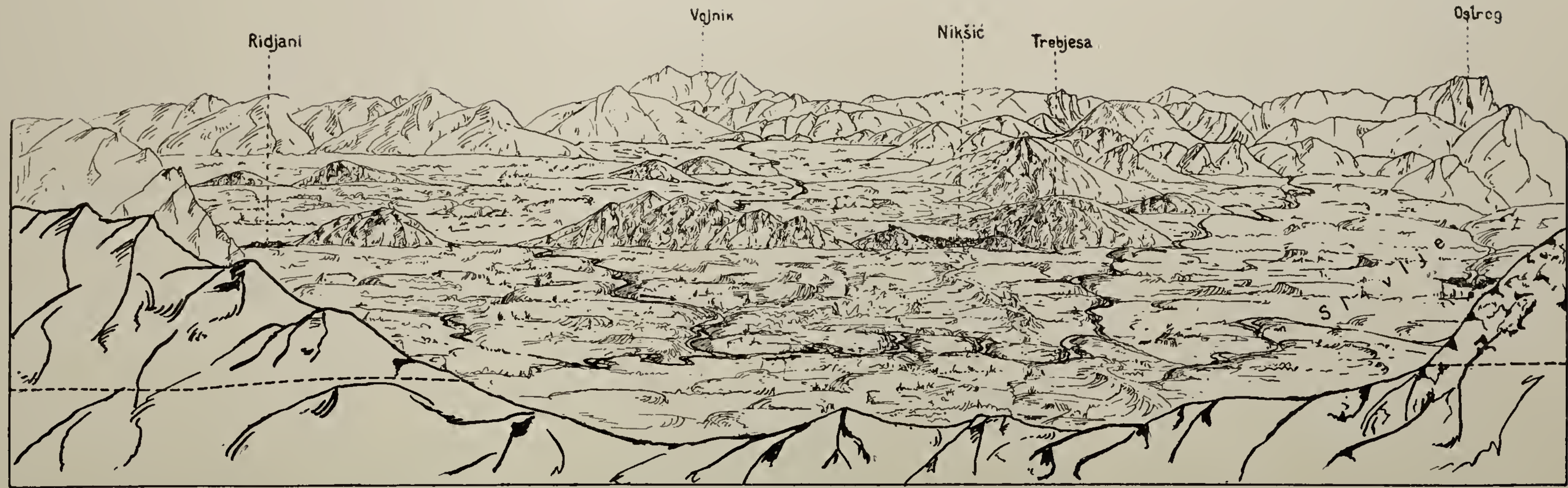

FIG. 10—General view of a polje strewn with hums. Polje of Niksic, Montenegro. Primarily of tectonic origin and now modified by stream action. Isolated hills are hums. The dashed line at left represents the course of the valley exit from the basin. Note the stream disappearing in a ponor at the extreme right.

Fig. 11—Synthetic sketch of forms of the Dinaric karst. References to surface forms: L, lapiez; D, dolines; SD, uvalas formed by union of dolines; U, uvalas; US, uvalas uniting to form a polje; UR, uvala captured by regressive stream action; P, dry polje; PP, polje periodically flooded; LAC, polje lake; PF, peneplain remnants. Sch, schists; C, limestones; S-S, impermeable layer giving rise to local sources of water (springs and doline lake). References to underground drainage: 1, dry zone; 2, transition zone (intermittently wet and dry); 3, wet zone (constant circulation); ss, submarine springs and line of hydrostatic equilibrium; ZA, zone influenced by pressure of sea water.

water that falls as rain, and there are no permanent surface lakes. Terraces of alluvium surround the former lake basins. This stage is the maximum of karst development, its maturity. Figure 6 shows the sort of relief that is characteristic. Such topography is found developed to its greatest extent in the Dinaric coastal strip of the Adriatic Sea in Dalmatia.

The mature stage may be said to have passed the moment that any part of the underlying strata is laid bare. Now begins the decline, or the stage of late maturity, during which the limestone is gradually stripped off the underlying impermeable strata. Wherever this happens the drainage can no longer flow underground, and surface streams appear. At first they are not above ground for any long distance, occurring most frequently where the edge of the limestone mass is eaten away by regressive erosion as well as undermined by the extension of subterranean caverns. Figure 9 shows this development. The streams issue from a cavern; and, except near the edges of the limestone mass, they frequently flow into another cavern. Figure 8 shows one of these streams, with the remains of former caverns still standing as arches over the gorge in which the stream flows. This process goes on all over the karst region; cavern after cavern falls in, and gorges are created everywhere; the edges of the plateau suffering more than the interior, as is shown in Figure 9. The resulting topography is seen in Figure 6. The polje flow is again covered in part by an intermittent lake, and streams flowing in deep gorges exist side by side with dolines and uvalas.

Old age is reached by the continuance of the same process of unroofing of caverns and regressive erosion, which takes place both at the edges of the plateau and along the sides of the gorges where the streams cut back and capture the dolines and uvalas. Figure 6 shows the last stage: a normal system of surface streams is in possession of the land, the former limestone mass being represented by isolated fragments which Cvijić calls "hums." The French term for these outliers is "buttes temoines." The hums are mere shells honeycombed with caverns. Excellent examples of karst topography in its later stages may be seen in Natural Bridge County, Va., and in the causse of central France.

HUMAN GEOGRAPHY—A REVIEW*

By Edward Yeomans

Nothing is so congenial to children as to go back into the mysteries of origins, back as far as the molten earth and back of that to the nebula. I know that because I have tried it. Children themselves have come out of geography in a very real sense, and they want to know where they come from. They have a right to know, and the result of that knowledge means tremendous things for them in the way of reverence and sanity and steadiness under strain. Back of their mother is the race of mothers, and back of the race of mothers is Mother Earth. Viewed in this light geography is a magical subject to children, not prose but poetry, not statistics but a picture of life itself. It is one of the native diets of childhood deprived of which a child cannot grow in grace and symmetry.

But, when they are given their first geography book and have their first lesson, somehow a door seems to slam in their faces, and they get a cold welcome to their Alma Mater. They are handed something about Arctic Circles, Tropics of Cancer and of Capricorn, the equator, temperate and torrid zones, parallels of latitude; and afterwards there is much to remember—hard to remember because so perfectly arbitrary and prosaic —about boundaries, about cities, about the "main products," and about the "main rivers," a great inert informational mass that will never be digested.

There you see most of the school children of this nation today studying the lesson in geography for tomorrow, with expressionless faces as a task analogous to arithmetic, and confronted by teachers who learned it in the same way. How can you expect anything from them?

What is the function of geography in a child's education? you ask, and you are quite convinced by now, no doubt, that here is another of those "new educational" cranks dilating his theory, blowing it up with the heat of his enthusiasm as toy balloons are blown. And it is just as fragile, you think—just as collapsible in the great currents of men's affairs, as it floats away into space.

The Function of Geography in a Child's Life

Dare I stop to inquire what, after all, *are* the great currents of men's affairs and whether we are justified in believing that children ought, if possible, to avoid confusion in a question so important as that and not get the

*J. Russell Smith: Human Geography, Book I: Peoples and Countries. 369 pp.; maps, diagrs., ills., index, John C. Winston Co., Philadelphia, etc., 1921. 10 x 7½ inches.

impression that they are local and purely personal and more or less trivial? For, before you can successfully answer the question about the function of geography in a child's life, you must actually have a pretty well established point of view about life in general—its main currents at any rate, the depth of them, the volume, the direction of flow.

Before you are qualified to teach anything at all you must have a background of thought and of experience, the larger area the better, which drains right through you and irrigates your class, otherwise you can fertilize nothing.

Order and Beauty

One of the characteristics, then, of that mysterious Gulf Stream in the ocean of man's history is this, that quality is more important than quantity; and another characteristic is the persistence of order and therefore of beauty, which things, applied to geography, mean that the crude, the formless, the chaotic, are always molded by irresistible forces into the restrained, the disciplined, the symmetrical—the fit to survive, the beautiful and therefore the useful. "Out of the strong cometh forth sweetness."

Four hundred years before Christ the end of all teaching and of all experience was stated, unconsciously, by the wisest man of that time; and you will be hard put to it to find a better statement. Socrates, coming one day out of a grove where he had had one of those conversational afternoons in which he so delighted and excelled, made this prayer as a token of his obligation: "O Pan—and whatever other deities may inhabit this place—help me that I may become beautiful inwardly and that all my outer goods may prosper my inward soul."[1]

This is the supreme function of geography in a child's life—that he may, by means of it, be helped to start those processes which will make him beautiful inwardly and save him from that submergence in wordly goods which would suffocate his spirit.

I might have some hesitation in saying that that was the function of geography rather than of some other subject if it were not for the fact that geography includes almost every other subject. You can not bottle up geography as easily as you can many other subjects. It has a ferment in it—human life—and it has a tendency to blow out corks and spread itself profusely over things, over everything. In order to bottle it you have to take the fizz out of it, and that's just what the old-style teachers did and do—and there it is, all by itself, not a bubble in it and with a very flat taste, of no value as a heart stimulant, or a brain stimulant, or an imagination stimulant. You might better pour it into the sink.

Of course it comes back to the question always of the teacher, and the teacher question comes back to society in general, and society in general has never felt the spell of geography very much and seems to be content with the standard teacher and book.

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[1] See Quiller Couch's wonderful book, "The Art of Reading."

A Good Book

Teachers of anything are rare, and therefore teachers of geography. And because they are so rare it is doubly important that there should be better books. For you can distribute a good book better than you can distribute a good teacher; and, besides, with a good book children can compensate somewhat for a poor teacher.

So I am going to take this occasion to discriminate between what I consider a poor geography and a good one. The poor geography is the kind my boys have been studying—that is enough to say—and with which I have been compelled nightly to help them through by reading it to them because they couldn't seem to read it to themselves and remember much about it. I had to dramatize it as well as I could and annotate it and enlarge on it and declaim on it and galvanize it into something that would register on those indifferent receivers. The land itself, however lovely or majestic, however filled with sunlight or starlight, heat or cold, vegetation or bare rocks or ice, seemed dull; and the people who lived in it, who drove dog teams or locomotives, camels or horses or elephants, who lived in tents or mountains and plains or apartments in cities, seemed dull too—people who never ate, who never talked, who never sang or shouted, who never showed any passion or fear or courage or nobility or depravity. In a word, it was a geography without *emotion*.

Emotional Geography Based on Fact

But this emotional geography, you may say, is not advisable as a steady diet, even if it could be maintained; but it is nevertheless true that it is the only kind boys and girls will assimilate. For one intellectual vibration you can start by colorless statements of fact there are ten started by an appeal to emotion *based on fact*.

If I say the earth is a sphere, flattened at the poles, 8,000 miles in diameter and 25,000 miles in circumference, rotating on its axis once in 24 hours and moving around the sun once in 365 days, three-fourths water and one-fourth land—I get a respectful hearing.

But when I go on to say that this means that we are traveling at the rate of 190 miles a second and at the same time spinning at the rate of 1,000 miles an hour; that all these exceedingly heavy continents and limitless seas bent around this ball have been whirling this way through black and frigid space for hundreds of millions of years; that these two dead things, turning so long on the spit before the fire of the sun, eventually cooked up men, women, and children of all sorts, red, yellow, black, and white, who do the strangest things in their various compartments where geography has them on exhibition today—then I get into the focal area of those minds.

So I go on to tell the children that inorganic, or what we call physical geography, is a stunning fine thing, a colossal thing, and is filled with an awful and immortal beauty, frequently with a deadly menace. But the

significance of it all lies in what it has produced through the long process which began with seaweed and by way of bugs, fishes, birds, and beasts of the field and forest has got at last down to children in schools, children in tents, children in snow houses and in mud houses and in shacks in the jungle, whose parents work at all manner of the most interesting things in order to get enough to eat and to wear, get money for tools, weapons, car fares, and automobiles.

The sun comes up and they all get up, put on their funny clothes, sometimes none at all, and begin doing the things geography compels them to do. The sun goes down and they lie down and rest, still creatures of the old sun and still creatures of the old geography.

It is the pupils' great privilege and distinction to be able, because they have been given these astonishing telescopic minds and microscopic minds, to look back over the long and arduous path their ancestors have come and also to hold up the spinning earth and see among the mountains and valleys, across the deserts and the seas, these little contemporaries of theirs, walking, running, working, playing, riding, hunting, eating queer food, talking queer words, fighting, singing, hating, loving, dying.

In other words we propose to teach human geography, a subject filled with action and with emotion but based squarely upon that immeasurably ancient physical geography which gives the final reason for and the final limit to—everything.

The Child Taken into Consideration

And here Dr. Smith's book comes in. When you look into this book you are tremendously encouraged. It is a good book because it is a wise book. It takes children into consideration first and facts into consideration second. It realizes that children, that childlike minds, get their best apprehension of fact through stories, through play, through occupation. For the purpose of teaching ethics you can't surpass the fables of Aesop or the parables of Christ. For the purpose of teaching geography you can't do better than take Dr. Smith's way and tell stories and make pictures. It is the same method applied to a different thing. Dr. Smith does not teach geography through his book for the sake of geography as much as for the sake of teaching; that is, he uses geography as an instrument in order to teach life, which is the way in which every subject should be used in the teaching of children. What children need is a very broad and simple comprehension and apprehension of natural processes, as we have said before, of discipline, of order, of proportion, of inter-relation, and of beauty—of all of which they are a very intimate part. And especially they need to feel the necessity for good will and co-operation in the human family as the only thing which can possibly save it from complete disaster, as the earth becomes more and more crowded. I do not say that Dr. Smith teaches ethics in his book; it would be a mistake if he did. But the by-products of a good textbook are its most important output, and "the

statement of the case" as one finds it there is such that there is far more hope for a valuable by-product than I have discovered in any other geography designed for children.

Collateral Reading and Music

While this article was never intended to be more than an appreciation of Dr. Smith's book, I might have made one or two pertinent suggestions. One would have been the necessity for a list of books for children's collateral reading, very carefully selected books for the use of both teachers and pupils, which contain whole stories or chapters or pages of prose or of poetry to intensify the pictures of places and of people by dramatizing them. But I find this has been arranged for in a separate manual published to accompany the geography. And also music! For how can you leave music out of geography? If you are studying Russia how desirable it would be to sing a Russian song—perhaps the "Volga Boat Song" at morning exercise—and the folk songs of other nations when those nations are being considered.

And also would it not be a salutary thing if children were made aware of the fact that our civilization, this modern Western thing which roars in our ears, is not a thing to be too proud of. It is a transitional thing and has terrible defects, to which they should not contribute. Some of their admiration should be spared for other civilizations, for different kinds of people. Who, for instance, are these amazing people called "Tungus"? Listen to this description of them in the January (1921) number of the *Geographical Review:*

> All observers speak in enthusiastic language of the temperament and moral qualities of the Tunguses. . . . "Full of animation . . . always cheerful even in the deepest misery, holding themselves and others in like respect, of gentle manners and poetic speech, obliging without servility, unaffectedly proud, scorning falsehood, and indifferent to suffering and death—the Tunguses are unquestionably an heroic people."

Consider what such people can contribute to us and also whether it would be kind for us to contribute anything to them except our profound admiration and respect.

Map Making and History

I do not think there is quite enough emphasis placed upon the making of maps. There should be plenty of map making, both drawings and relief maps of "plasticene," and these maps should be considered, in a sense, works of art. Making maps should be a most important feature of any work in geography.

And of course the history teaching must always go along with the geography. These two things can never be separated and be intelligible. Either the history classes must make the maps or the geography classes must make them.

I have talked about a considerable number of things, perhaps, which Dr. Smith could not very well include in his book. I have let the subject of geography overflow the vessel it has to be carried about in—namely, the book. But I do not think I have in any way exaggerated the function of the teacher who uses the book and who catches the implications in it and the by-products which it can produce in proper hands.

The Most Educational Thing in the School

But, you say, there is not time for all this; why, at this rate geography would take half the school hours, or at any rate so much more than can be allowed from the very serious matters of arithmetic, grammar, English, French, etc. But when geography is correctly taught nothing will be more reasonable than to let it take the time because it will then be the most educational thing in the school. It is the most educational thing in nature, so why shouldn't it be in school? Simply because school has nothing much to do with nature—isn't that the answer?

GEOGRAPHICAL RECORD

NORTH AMERICA

Relations Between Land and Sea on the Northeastern Coast of Labrador. To the physical geography of a region still little known scientifically A. P. Coleman makes a welcome contribution in "Northeastern Part of Labrador, and New Quebec" (*Geol. Survey of Canada Memoir 124*, Ottawa, 1921). The most impressive feature of the region is the relation between sea and land. The coast is one of the most bold and rugged in the world. Great promontories with nearly vertical cliffs 1,000 to 2,000 feet in height run out between an intricacy of deep fiords, and deep and narrow channels separate the fringing islands from one another and the mainland. On this proverbially stormy coast wave action is profound; it is "the most important destructive work now going on in Labrador, since the small glaciers are doing little, the clear water rivers are cutting but slowly, and general weathering must be going on very deliberately in a region where snow lies for eight or nine months and the summers are cool and comparatively dry." During the months of July, August, and September, when the fishing fleets frequent the shores, northeasterly winds of a monsoonal character are dominant. Gales are common and violent, especially in September. During their occurrence waves at exposed places pile up to more than fifty feet above sea level and the spray is hurled a hundred feet up the sides of the cliffs. The shore forms show the rapid headway being made by marine erosion. On the sharp cliff faces there are characteristic examples of hanging remnants of glaciated valleys, and there is no suggestion of recent faulting. The coast appears straight on small-scale maps, but in detail the seaward front trends in all directions.

Along most of the coast the tidal range is not great, but off Cape Chidley, the northern extremity, it amounts to from 30 to 50 feet in the spring tides whose force and magnitude are not surpassed even by the famous tides of Fundy. In places tidal anomalies have been observed; thus in Nachvak fiord early in August, 1916, there was a difference of two feet in the height of the two diurnal tides.

The third great dynamic force of the sea, the ocean current, also has a profound influence on this coast. The ice-laden Labrador Current is the main stream, though there appear also to be minor currents. Occasionally spruce wood is drifted into the northernmost fiords, swept into the main current apparently by northeasterly currents from Ungava Bay. The prevalence of on-shore winds means that the summers are cool and foggy: "the occasional southwest winds felt almost sultry in contrast with the ice breath from the waters of the Arctic current." The easterly winds, also, drift floe ice into the fiords, thus further contributing to the lowering of temperature. In connection with the comparatively rare westerly winds of summer a chinook effect is worth noting. The deeper north and south valleys have a comparatively warm dry climate. In late August the grassy floor of one such valley opening into Nachvak fiord was sere and yellow, and above the valley flat on the eastern side berries ripened much earlier than at Hebron 60 miles farther south.

The Temperature and Precipitation of Alberta, Saskatchewan, and Manitoba. The climatic limit to cultivation is perhaps the most important element to be considered in the development of western Canada's unsettled lands, and it is highly desirable that temperature and rainfall data in great detail be made available. This the Meteorological Service of Canada is doing in a series which began appropriately with British Columbia in 1915 (*Geogr. Rev.*, Vol. 1, 1916, p. 228), and which is now followed by "The Temperature and Precipitation of Alberta, Saskatchewan and Manitoba" (Ottawa, 1920), by A. J. Connor, Climatologist. Tables and maps constitute the body of this publication, most of the interpretation and application being left to others. The tables show for each year the dates of first and last frost at 204 stations and the monthly rainfall at 295 stations, arranged by watersheds; and the monthly means and extremes of temperature, rainfall, and snowfall by decades at the 38 stations with adequate records. The 16 maps (on large township base map, scale about 40 miles to an inch) show in great detail the monthly mean maximum and minimum temperatures and the April–May, June–July, August–September, and mean annual precipitation. Isotherms are given for every 2° F. and isohyets for every 1 or 2 inches.

The coldest district is near Hudson Bay, where in January the mean daily minimum temperature is below $-32°$ F. and the maximum below $-15°$ and in July below 40° and 66°, respectively. In summer, however, the Rocky Mountains are colder. The hilly region west of the large Manitoba lakes is cold, the mean daily minimum and maximum being in January below $-18°$ and 3° F. and in July below 48° and 74°, respectively. The hills and dissected high plains not far east of the Rockies are also cold, being somewhat warmer in winter and colder in summer (higher altitude) than the eastern hills. Along the border of western central North Dakota the mean minima in January are as low as $-10°$ F., where the cold waves seem to have their freest sweep southward. The warmest district is in southern Alberta. The highest winter temperatures (January mean daily minimum below 4°, maximum below 30°) occur near the mountains, where the chinook blows most often, eating the snow off the cattle ranges; and the highest summer temperatures (July mean minimum about 52° to 54°, maximum about 78° to 82°) are experienced farther east, about Medicine Hat and on the plains of southern Saskatchewan and Manitoba.

The average annual precipitation ranges from about 10 to 20 inches, 15 to 25 per cent of which falls in April–May, 30 to 40 per cent in June–July, 20 to 25 per cent in August–September, and only about 30 per cent in the colder half year. The April–May rainfall is greater than that of August–September in the west and less in the east, possibly because of the coldness of the eastern lakes in spring. The belts of hills (generally forested) are marked by rainfalls of 5 to 10 inches more than those of the neighboring lowlands, and in the Rockies of southwestern Alberta the excess is 20 inches (total, 31 inches). The southeast is in general the wettest, and the far northwest the driest.

Within the regions generally favorable to agriculture so far as temperature is concerned, the local uncertainties of rainfall are of prime importance. On this account Mr. Connor suggests the establishment of rainfall stations several years before settlement, especially in the climatically little-known region north of the 53rd parallel.

Charles F. Brooks

EUROPE

The Arrangement of Rural Population in Belgium. The appearance of a paper entitled "Carte régionale du peuplement de la Belgique," by Marguerite Lefèvre (*La Géographie*, Vol. 36, No. 1, June, 1921, pp. 1–34), is particularly opportune on account of my population study appearing in this number of the *Geographical Review*, and is of further interest in its confirmation of the conclusions announced in a paper published in the *Review* last year (Vol. 10, Oct., 1920, pp. 223–240).

Mlle. Lefèvre has based her investigation primarily on the Belgian topographical maps of 1:100,000 scale, combined with direct observation of the ground when demanded by the circumstances. She has concluded that the arrangements of the present day form definite regions of human significance, quite apart from all physical considerations, and may be subdivided into units which she terms *domains*. There is a region of dissemination in the north of Belgium separated from a region of agglomeration in the south, by a well-marked boundary, passing through Tournai, Seneffe, Brussels, Malines, Louvain, Léau, Tongres, Maeseyck. There are five domains in the north, and four in the south. The boundaries are transitional, and the characters of one domain may be sporadically encountered right within a neighboring one. The accompanying map is thus a tentative representation of the conditions.

The littoral domain comprises the seaside residences of the coast and the groups of small cottages in the cultivated "pannes" of the dune belt. Landward of these is the domain of large, isolated farms of the "polders." Domains of dispersion in bands are found in the northwest of Flanders and in the polders of the Scheldt. In the provinces of Antwerp and Limbourg, which are thinly populated, are found small hamlets and dispersions along the highroads. The domain of maximum dispersion, which is veritably "dusted" with houses, exists in Flanders, between Dixmude, Audenarde, and Courtrai. The houses are scattered everywhere, and the communal centers are only indicated by the church spires. Slight variations occur in Flanders, as where the Forêt d'Houthulst has caused a tendency towards clustering, or in west and French Flanders, where the small houses often stand in groups of two or three. Extreme dispersion exists in the Pays de Herve, also, where houses again occur in groups of two or more. In southwest Flanders, northern Hainault, and parts of the

provinces of Antwerp and Limbourg, the development of large farms has emptied small areas immediately around them, rendering the "dust" less dense. This is regarded as a subform of the domain. Another subform is found west of Brussels, and in southeast Flanders where the innumerable roads, running in all directions, are lined with houses. These forms comprise the northern region.

In the region of agglomeration we have first the so called "nebulous villages" mainly in the Namur basin. They are regarded as the transition between the two regions. The normal type is expressed in the form of large settled patches, the houses lining the roadways. An exaggerated form exists in the industrial regions where the fields have shrunk in size to mere gardens. A further type, less dense than the normal, occurs in the basins of the Vesdre and Amblève. These constitute one domain. The domain of nuclear villages has two subdivisions, the large villages to be seen in Hesbaye, and the small, thinly scattered villages of the Ardennes, where house stands next to house. A domain of crossroad villages exists in forested localities, as around Sivry. The last domain recognized is characterized by an entire absence of villages, and very few farms, as around Chimay.

The origins of the present day forms are sought in ethnographic history and environmental and economic influences. The purely ethnographic explanation advanced by Meitzen (A. Meitzen: Siedelung und Agrarwesen der West- und Ost-Germanen, Berlin, 1895), is discussed and discarded as unsatisfactory. A pronounced ethnographic influence has nevertheless been at work. In Roman times the *Hofsystem* prevailed in the north (a system of small, clustered pastoral communities of Celtic origin), while the villa system (groups of closely and strongly built dwellings) existed in the south. As forms, they were essentially alike. The Frankish invasions of the third century established the *Gewannsystem* in the north, a one-field, agricultural system, looser in form than the older Hofsystem but, all the same, clustered in its nature. A *tendency* towards dissemination was thus introduced in the north, while the south remained unaffected.

Environmental influence is first worked out historically. The general course of events is very like that demonstrated for the Siebengebirge. In Belgium three periods are discernible. The first stretches from the earliest times to the beginning of the ninth century and was a period of slow but steady occupation of all the available open tracts. Places which originated during this period may often be identified by the terminations of the place names, but the original foundations of the villages concerned are no longer discernible. The period of extension began early in the ninth century. Active attack was now made on the forests and marshes. The earlier seats of attack are here also traceable by the place names. Overpopulation evinced itself in the interior in the ninth century and was relieved by a peaceful colonization of the reclaimed marshes. The final clearing of the forests and reclamation of the marshes, the latter aided by the retreat of the sea, were accomplished between the thirteenth and fifteenth centuries. The former was instigated in the south largely by the monasteries, and both activities were encouraged by the counts of Flanders. In the latter half of the nineteenth century the period of economic progress began.

Physical influences are numerous. The forests are regarded as having been of primary importance. In the first period their influence was negative. When expansion started, the northern and southern forests reacted differently, owing to their different subsoils. The great northern forests (La Charbonnière, for example) were almost obliterated and with especial ease in northern Flanders and the Campine, where they were less dense and more coniferous. They were supplanted by agriculture. The Ardennes were cleared only in patches, and a mode of life was followed there which has now disappeared. In the north the nebulous villages grew in places as the forest was cleared. In the south the crossroad villages arose. The depth of the water table has been of great importance. In the north it is generally close to the surface, and thus permits dissemination, though this result need not necessarily follow. In the south it is deep below the surface, and life clings to the valleys. The final question is, can each dwelling have its own well, or must one well suffice for a whole village, in default of stream supply? In the latter case, agglomeration will prevail, as in parts of Brabant and Hesbaye. The nature of the soil resolves itself into a question of soil quality and condition of the surface during damp weather. It has reacted to produce the large farms of the polders, the dispersion in bands in the polders of the Scheldt, and the similar dispersion, though for a different reason, in northwestern Flanders. The method of exploitation is next considered. The large farm is believed to lead to clustering, as in Hesbaye, and the agglomeration southeast of Brussels is believed to be the result, in part, of an obsolete pastoral method. The shifting soils on the banks of the Meuse on the Dutch fron-

tier have also led to the establishment of clusters on the firmer patches. Topographical forms and climate are of minor influence in Belgium, but individual villages are sited in hollows to avoid the rough, cold winds. It is evident from this exposition that all the physical circumstances also have favored the development of dissemination in the north and of agglomeration in the south.

Economic influence has been most powerful during the last period, old forms having adapted themselves to the newer conditions as in the Campine, where the highroads and railroads have exerted special attraction, and in the industrial regions of the Namur basin, where the nebulous villages have extended to the exaggerated form of spider web groups, particularly in Hainault.

Mlle. Lefèvre's careful investigation of the subject was made, apparently, in ignorance of my first paper on rural populations, to which reference is made above. It is thus a most welcome piece of independent evidence confirming the main conclusions reached by me. Bearing in mind that my own investigation attacked the problem in a general way, and that Mlle. Lefèvre has dealt with Belgium in particular, it is remarkable that the types she has distinguished and their underlying physical controls and evolutionary development correspond almost completely with my conclusions. For review purposes I have used Mlle. Lefèvre's terms, but the reader will have no difficulty in identifying ,say, her "dispersion en bandes," with my "linear dispersion," etc. The important influence of the forests, admirably established in her paper, had entirely escaped my attention. In connection with my paper in the present number, the identification of domains is very important. Their subdivisions are small in extent and somewhat mask the correspondence between Mlle. Lefèvre's map and the one I have published, but there is here also a very welcome agreement.

In criticism, I cannot agree with the author that the domains are independent of physical circumstances. Throughout her paper the geological basement is almost entirely disregarded. No mention is made of the important work of Leriche, and no direct significance is attached to the *noms de pays*. Yet, the *noms de pays* are an expression of folk consciousness of the physical unity of the district and link the human with the physical factors. They also indicate the approximate extent of the natural districts, which are essentially geological units and which determine most of the physical conditions, both of hydrology and soil. The arrangement of population depends upcn the siting of dwellings, and, though other factors also operate, site is primarily determined by physical conditions. A comparison of the topographical and geological maps is a convincing way of realizing the connection between the physical circumstances and the human adaptations to them. For instance Mlle. Lefèvre depicts a subdomain of nebulous villages of low density in the northeastern Ardennes. They occur on the Cambrian rocks of the Spa district and are absent on the predominant Devonians. Similar conditions obtain on the corresponding Cambrian tract in the southwest, around Rocroi. I have disregarded these minor variations in my own treatment of the subject, but they are of some importance. The vertical element in village distribution, for instance in Condroz, appears to have escaped attention, and so has the hydrological line in the Ardenne Condrusienne. Two very important economic questions have not been considered. The first is the effect of the systems of land tenure, on the disappearance of the old social systems. The second is the significance of the sizes of farm holdings. It is one thing to say that large farms developed in Hesbaye and led to agglomeration, but quite another to say that in Hesbaye, which is on the Cretaceous chalks, it requires a larger area of land to make farming profitable than it does in Flanders.

The paper is well illustrated with diagrams and a map, and supplies many useful references, especially to German work. The author is to be congratulated on the clearness and thoroughness of her work, and it is to be hoped that she will extend her researches to a consideration of the Belgian towns and cities.

M. Aurousseau

Urban Geography: A Study of German Towns. A general study of the towns of Germany by Walter Geisler, which has recently appeared ("Beiträge zur Stadtgeographie," *Zeitschr. der Gesell. für Erdkunde*, Berlin, No. 8–10, 1920, pp. 274–296), is of considerable importance. An intensive study of Danzig drew Geisler to numerous conclusions, which he has tested by applying them to other towns in Germany; he now announces a series of broad, general principles underlying the structure of the German town, which should have extensive application elsewhere. He treats the town as an object, an integral part of the civilized landscape, and seeks to explain its general bodily appearance, ground plan, and structure.

In urban regions we meet man's greatest transformations of the landscape. When a spot is first occupied the best available land is taken first for house construction, and the streets are then laid out in accordance with the scheme. The ground plan is thus determined, and the streets thenceforth become the *conservative element.* To understand the ground plan the history of the town must therefore be traced in full. German towns, with a few exceptions, have not arisen from villages. They have been deliberately founded, often by a ruler, and so come to have a set form. The types vary with locality and age. The old towns west of the Elbe are irregular and have a single or a forked main street as their ancient foundation; but later, in the thirteenth century, they took on an outlined form through circumvallation. The somewhat newer towns on the flat ground east of the Elbe, mostly founded by the Teutonic Order, are more regular in plan and show a systematic arrangement of constructions of public significance (castle, market place, church, etc.). They are well represented on the Vistula. In the Roman foundations in western Germany the old street mesh still survives (Cologne), but they follow no regular system.

The present street plan is the result of expansion. This has taken place either by natural outgrowth according to necessity, or by the conscious foundation of new, isolated suburbs, as in the west. The towns of the middle ages were spacious, enclosing plenty of land within the walls. This was necessary for defense but was in part the result of monastic influence. Hence, from the thirteenth to the nineteenth century, town growth was not accompanied by peripheral expansion. The towns used their open land, or new towns were founded, especially in the east. The growth of the thirteenth century transgresses the walls. There were thus three periods of growth, now represented by three series of streets, those of the foundational period, the *Ringstrassen*, due to the removal of the walls, and the outer streets of the nineteenth century. In the east the walls have been preserved and are considerable obstacles to development. The nineteenth century streets followed natural features at first and then were laid out with mathematical regularity. Now attempts are made to relieve the monotony and to bring them into harmony with pre-existing features. Main thoroughfares, main streets, and distributing streets are to be distinguished.

The ordinary town plan gives little information of value concerning the spaces occupied by buildings. The kinds of buildings need to be distinguished, and public buildings are divisible into three main groups. The traffic and administrative buildings seek with great difficulty to penetrate the heart of the town. Cultural institutions (*Kulturorgane*), if of the type only once visited, such as museums, seek the inner town, or a position on the *Ringstrasse*, on its margin. Those used frequently, like schools or churches, are evenly distributed. Others, like hospitals, seek secluded places. The military buildings are placed on the walls in the east and are removed from positions of activity in the west. Industrial buildings are of three kinds. Business houses (excluding those concerned with daily supply) line streets which coalesce to form the *core* of the town. The core has a low dwelling density and is represented in towns of all sizes. The thoroughfares radiate from the core and are wanting in small towns. Their extent and the size of the core depend on the extent of the hinterland. Warehouses characterize maritime towns and choose poor ground, if the handling of goods is not thereby impeded. They have often been replaced by dwelling houses in consequence of the increased draft of ships, which demands their migration (Speicher Insel, Danzig). Manufacturing buildings avoid the core entirely.

Dwelling areas have often only recently been separated from the manufacturing areas. Such trade as requires little room may exist here. The aspect of the town depends upon the height of the houses. This is best expressed by the number of stories. Their number increases with the size of the town, but large towns show great irregularity. House height is easily represented on a map, the striking feature being the great height of the core.

The houses themselves are always younger than the streets by a period ranging up to three centuries. Only the monumental buildings are as old as the streets. The classification of house types requires a broader basis than the architect would employ, and the classes distinguished include various architectural styles. In the town proper there are three main types: the gable house of the fifteenth to seventeenth centuries, the *Langhaus* (with hip roof) of the eighteenth and nineteenth centuries, and the lodging house of the nineteenth and twentieth centuries. It is possible to map them by districts, but some subtypes have a remarkable territorial distribution. The *Langhaus* type, for instance, is common in middle Germany, as at Cassel and Weimar. Out from the inner town are the semidetached and detached houses of the suburbs. The problem of making a map which would show both height and style of houses has not been satisfactorily solved. Land free from buildings—

parks, gardens, squares, etc.—should be mapped with especial care, owing to its tremendous economic and hygienic importance.

Population density may be expressed and mapped by the average number of residents per house, when the map will be found to correspond remarkably with the map of house heights. It may also be determined as kilometric density by town subdivisions. In these circumstances, the relation between the number of buildings and the open spaces should be carefully determined also. Choice of suitable subdivisions is difficult, and generally the administrative areas, like police districts, are most unsuitable.

The limits of the town are most difficult to determine. Hasse sets the limits at the line of abrupt decline of population density. Hassinger uses the limitations of the range of traffic, based upon the mean accessibility (= mean time of passage plus ½ time of delay) of the core from the suburbs. This is unsuitable, as many town dwellers have little concern with the core, and there is often more than one centralization point. The line of encounter of rural and urban activities has also been proposed and is very satisfactory for small towns like Biala, but with large towns there is an interpenetration of activities. Schülter's four zones of urban influence form a most useful conception, but in these days most villages show distinct urban influence, and farmed land between isolated suburbs always gives hints of pending absorption into the town. We are forced to fall back on a fast boundary, but it is useful to distinguish a natural settlement area (*natürlicher Siedlungsraum*) within which is a settled surface (*besiedelte Fläche*), as the relation between the two is a valuable measure of town development. Where the latter occupies the former fully, there is little opportunity for dilatation; and, if neighboring areas press one upon the other, we have the condition of grouped towns, illustrated by the industrial region of Rhenish Westphalia.

It is impossible in a mere abstract to avoid giving the impression that Geisler has often recorded nothing but the obvious, but the importance of the ideas expressed is amply verified by the discussion of numerous interesting examples from all parts of Germany. The paper is a welcome indication that the most intricate province of human geography will ultimately reveal its governing principles. Two things in particular are suggested. The first is that the investigation of the subject is best undertaken from a biological standpoint. We are concerned with the interactions between society and its surroundings. Society, the collective organism, is the highest expression of the organism, and for its own maintenance it sets aside organic groups, largely expressed as towns and cities. These may be examined according to function (physiologically), according to form (morphologically), as Fleure has done (*Geographical Review*, Vol. 10, 1920, pp. 357–374), or according to tissue (histologically), which is Geisler's method. The second indication is that all large cities would find their problems and development much more favorably under control by the employment of well-trained urban geographers.

M. Aurousseau

On Population Estimates and the Case of Constantinople in Byzantine Days. A. Andréadès, professor of financial science in the University of Athens, went on a voyage of discovery into the dim shadows of third-to-thirteenth-century Constantinople to ascertain its number of people ("De la population de Constantinople sous les empereurs byzantins," *Metron*, Vol. 1, 1920, No. 2, pp. 68–119). He comes back convinced it was a city of a million in its best periods, dropping to a half million in dark days, and having 180,000 to 200,000 at its fall. The Byzantine Empire had from 15 to 20 millions. The estimates of the historians, he says, that the city had from half a million to a million are entirely conjectural. His own appear to be based on love of all things Hellenic, confirmed by faith. He wants to think of Constantinople as a city of a million. He reviews the gossip of the ages, welcoming large estimates and disdaining small ones. He would consent to any arbitration of opinions that was pledged to result in his favor.

Constantinople has never been counted, and there is no other way than counting to ascertain the number of inhabitants. There was a lively dispute about Detroit a few years ago. The citizens thought it had a million people. The census officials estimated it between 600,000 and 700,000. This today, in a land of statistics, halfway between two countings of the people, with a larger fund of information available in infinitely more exact form than we have of any period in antiquity.

If Byzantine writers of every century had written down their opinions of the size of their city, it would prove nothing at all. None of them ever made the attempt. The size of a city is not determined in that way. Mankind in Byzantine days had none of our modern

familiarity with the notion of a million. Possibly it is not a very definite idea with many of us today, but at least we talk about it freely. Neither Greek nor Latin speech had any such word as a million in current use. Even now there are very few cities in the world containing a million: none in Australia or Africa, two in South America, four in North America, and eight in Europe. In Asia there are four counted ones in India and Japan with perhaps two or three uncounted ones in China. China is worth a word of comment in connection with estimates of old Rome and Constantinople; for it is not possible to determine the size of Chinese cities at all closely, although we have in addition to all the analogies used in the arguments about the ancient towns the possibility of comparison with other towns that have been counted—an enormous advantage—and the important privilege of personal inspection.

Andréadès does not think Foord's comparison of the acreage of Constantinople and London is fair. He prefers the closer-settled Paris or the congested parts of Naples. Now, if he is serious, he thinks of Constantinople as settled like the denser parts of Naples all over the peninsula. Immediately he admits that this method would have its dangers too, for "it would end in colossal figures"! As if we were to judge our method right or wrong according as it arrived at about the result we thought right. Foord thinks Constantinople never had 500,000 people. Andréadès does not like this result.

Somewhat in the same spirit he characterizes as an "example of vagueness" Beloch's statement (1898) that "Constantinople was the only large Christian city with population over 100,000, and probably a good deal over." He quotes Sozomen's boast that Constantine's city yielded nothing in size to Rome to argue from it a population of 800,000, regardless of the three objections (1) that a boaster may state the opposite to the truth, (2) that Rome may not have had 500,000 people at any time, and (3) that Sozomen did not know how large either city really was.

Rome, we are told, had in 412 A.D. about 46,603 *insulae*, in which poor men dwelt, and 1,797 *domus* of the rich. Constantinople had 4,387 *domus* and an unknown number of *insulae*. Andréadès assumes that Rome had a million people; and so he thinks if he knew how many *insulae* there were in Constantinople he would know its population. He is sure that the poor were very numerous indeed. However, the evidence he cites to prove it is mainly the inducements held out to the laboring class to come there. That may indicate not that there were many of them, but that they were scarce and desired! Andréadès states that Bury has written him that Constantinople must have been larger than Milan, and Milan had over 600,000 in 538 A.D., "because the Franks massacred 300,000 males when they took it in that year." I fancy the massacre was exaggerated, and also the size of Milan. St. John Chrysostom is quoted as saying there were 100,000 Christians in Constantinople. On this Andréadès makes the comment that "criticism regards the statement as a copyist's error." Also Chrysostom said there were 50,000 "indigents, who were a tenth of the citizens." Of this the author says "We will not stop on this text but ask, How did Constantinople get so many people?"

Villehardouin says that in the conflagration that accompanied the capture of Constantinople by the crusaders in 1204 more houses were burned than "there are in the three largest cities in France." Does Andréadès suppose that Villehardouin had counted the houses burned, or those of the three largest cities? He was doubtless trying to convey the idea of a very large number.

Less excusable still is the treatment accorded to the statements of Kritopoulos, that 4,500 were killed at the fall of Constantinople. This, says Andréadès, must refer only to soldiers killed. From the horrors told of the massacre he judges that 50,000 or 60,000 must have been killed in all. There is no hint in all the gossip cited that Constantinople had over 500,000 people.

The fact that old Rome and old Constantinople belonged to a prestatistical epoch does not justify the application in our day of prestatistical forms of reasoning. Old writers tell easily of enormous losses in population by war and pestilence. Much reference is found to them here. Consider the effect of the war on the population of Europe. Marin's figures give as the killed in battle, dead of their wounds, and reported missing, 8½ millions for the four years. Now, normally Europe has been increasing in population about 19 millions every four years, so that, unless the civilian deaths directly traceable to the war or the changes in birth and death rates so chargeable have amounted to 10½ millions, the total population at the end of the war would be greater than at the beginning. The fearful famines of India have never diminished the counted population of that country except in the single

case of the period 1861–1871, in which occurred a falling off of one-tenth of one per cent.

One thing made clear by modern census counts is that population grows very strongly and steadily in all countries and that the industrial expansion that came in with the railway in the nineteenth century enormously favored and facilitated urban concentration by making it easy to gather food and supplies from wide areas. Now by definite count it is known that the most favoring agencies and the great expansion of the British dominions did not bring London up to million size till 1802, though all the world contributes to supply London, as certainly never happened to any city of antiquity. Paris did not reach that size till 1850, New York not till 1870, Vienna not till 1878, and Berlin not till 1880. Calcutta in the "teeming East," with all the stimulus of British commerce, did not attain a million till 1900. Under the different conditions of ancient life, with their feeble means of transportation, Old Rome and Constantinople would have been enormous with populations of 500,000 people.

MARK JEFFERSON

AFRICA

Spanish Penetration in Northern Morocco. Whether "Africa begins at the Pyrenees" or "Europe ends with the Sahara," Spain's claim to a special interest in Morocco is well founded. Even aside from the fact that the Strait of Gibraltar has not destroyed the geographical unity of the lands to the north and the south of this narrow passage, mere proximity would seem to make Spain's interest in the North African regions more direct than that of other European nations.

In spite of this fact, her penetration of the region has been very slow. First on the field, she has made the least advance in effective occupation of the African lands. The line of coast forts, *presidios*, established on these rocky points have served to protect her shipping from pirates and have provided sites for convict settlements. They have afforded her also a pretext for intervening occasionally in the political affairs of the Moroccan Empire, as when, after the war of 1869, the Spanish-Moroccan treaty opened the ports of the empire to world commerce. But, until recent years, her penetration went little farther. The present Spanish zones of influence have been defined in particular by the conventions of 1904 and 1912. The northern zone includes the districts of the Jebala and the Rif, roughly bounded on the south and east respectively by the Lukkus and the Muluya, excluding Tangier, which, with a small surrounding territory, was made an international area. The southern zone includes the quite separate territories of Ifni and Rio del Oro on the Atlantic coast farther south. In addition to these zones Spain holds as formal possessions the beforementioned coast forts which have been held practically continuously from early dates, the Zafarina Islands (1848), Melilla (1497), Alhucemas (1673), the Peñón de los Vélez de Gomera (1508), and Ceuta (1580); all of them mere rock-supported citadels that occupy jutting points along the Mediterranean coast, partially or completely disconnected with the mainland. Beyond, she maintains but a precarious hold, as the recent successes of the native armies have shown, when the Spanish troops were driven back to the very gates of Melilla and her entire position was threatened. (For a description of Spanish Morocco see an article entitled "Marruecos," by Abelardo Merino Alvarez, *Bol. Real Soc. Geogr.*, Madrid, Vol. 62, 1921, pp. 1–168, with map.)

We need not look far for the cause of Spain's slight success in Africa. Part of it no doubt lies in the *indole* of the Spanish people themselves, part in the policy followed by the government. A large part of the difficulty lies, however, in the character of the land and its inhabitants.

A forbidding coast line, composed chiefly of the jutting ends of mountain ranges, or of high cliffs running parallel to the coast, has left little opportunity to tie the captured islands or promontories to a hinterland upon which they might be made to depend. Though numerous streams break through this series of cliffs, most of them reach the sea through deep narrow gorges which, if penetrated, give access to but very limited districts. So complete has been the separation of the Spanish coast *presidios* from the adjoining territory that even firewood and water sometimes have had to be brought to the garrisons from the Balearic Islands or from Spain, while the garrisons have had constantly to be on their guard against attacks from the shore. In the Peñón de los Vélez (a rocky islet only 90 yards from the coast) the occupants of the fortress have found it necessary, on occasion, to cover the streets with bags of sand in order to protect themselves from rifle fire directed against them from the cliffs of the mainland. Don Alfonso Merry del Val in "The Spanish Zones in

Morocco" (*Geogr. Journ.*, Vol. 55, 1920, pp. 329–349 and 409–422) tells of the difficulties encountered by the Spanish in their attempt to penetrate the interior.

The little-known mountains of the Rif and Jebala together form a physical entity (sometimes known as Little Atlas), closely related to the Betic Cordillera of southern Spain, quite distinct from the Middle and High Atlas. The northern system contains far less level land than the Atlas proper. Exposed to a heavier rainfall (though still rather dry in the eastern section) the hills have become highly dissected, forming an intricate network of hills and valleys.

The only advance made by Spain has been where she took advantage of the few bits of level land that exist within the territory of her zone. Thus at the western base of the Jebala, between the Strait of Gibraltar and the Lukkus River there is a small area of lowland over which, operating from the ports of Arzila and Laraiche, the Spanish forces have succeeded in establishing their authority, but only as far as to the foot of the hill country. The inhabitants of this region, sedentary agriculturists for the most part, have long been accustomed to submit both to the oppressive measures of the Emperor and to the attacks made upon them by the people of the hills. They offered little resistance to the Spaniards, probably being glad to seek the better protection of Spanish authority.

Again, at the eastern foot of the same range, from Ceuta southward to beyond the Wadi Martil there is a stretch of level land, chiefly sandy soil, little used except in the neighborhood of Tetuan. Taking the stronghold of Ceuta for a base, the Spanish have been able to reach the important center of Tetuan and even to threaten the sacred city of Sheshawan (Xexauen), upon whose streets, up to the present time, it is said, no white man has ever trodden, though it is less than 100 kilometers from Ceuta or from Tangier.

The only remaining plains are at the extreme eastern end of the protectorate. Where the Rif mountains give way to the valley of the Muluya and the Mar Chica there are extensive flat lowlands. The valley of the Kert also contains some level lands, as does also the Meseta between this latter and the Muluya basin. In these plains some of the inhabitants live in small villages or clusters of villages, and practice agriculture on a limited scale, chiefly without irrigation or with the simplest of canal systems. Others, particularly on the steppes of Mtalsa and Guerruao between the Muluya and the Kert valleys, are principally pastoral and nomadic or seminomadic, moving their *jiams* (tents woven of wool or of *esparto*) from place to place in search of pasture for their flocks or living in temporary structures made of posts and woven grass. Here Melilla has served as base of departure. By force of arms and by peaceable means the Spanish have been able to occupy much of this level country, although the proximity of ranges of hills such as the Quebdana and the hilly promontory of Tres Forcas has afforded frequent opportunity for attack by rebel leaders. It was from this district that large quantities of iron were mined and shipped to England during the war. Roads have been extended into the surrounding regions, and two short lines of railway have been built out from Melilla. The recent uprising of the tribes in this territory seems to have undone much that had been accomplished towards a permanent reduction of the interior, as, according to reports in the daily press, the Spaniards have lost, temporarily at least, almost all except the fortified city of Melilla itself.

French West Africa. The exhaustion of France during the war and the fear of becoming more and more dependent for food and raw materials on foreign countries has aroused among the French people of late a lively interest in the resources which their colonies offer for the supply to the mother country of products which she either cannot produce herself or cannot produce in quantities sufficient to satisfy the needs of home consumption. Gallic imperialists believe passionately in a self-sufficing French Empire and see in their great and, as yet, barely touched African domains a magnificent field for the exploitation of agriculture and of mineral wealth to benefit *la Métropole* and, incidentally, the colonies themselves.

This interest has been focussed to a very large extent on French West Africa, that enormous tract comprising, in the Sudan, the valleys of the Senegal and upper Niger and connected with the Atlantic and Gulf of Guinea by four broad "corridors," the colonies of Senegal, French Guinea, Ivory Coast, and Dahomey (which now includes part of the former German Togoland). From the administrative point of view the region was entirely reorganized in December, 1920; among other reforms the old military territories of Mauretania and the Niger were given administrative autonomy as colonies, and the name of the former colony of Haut Sénégal et Niger was changed to "Soudan Français" (*Colonies*

et Marine, Vol. 5, 1921, pp. 161–178). During the war an extremely valuable bibliography and estimate of the scientific work of all sorts that had been carried on in French West Africa appeared in *Renseignements Coloniaux* (*Suppl. à l'Afrique Française*) for January-February, 1916, pp. 3–26, which, together with Joucla's "Bibliographie de l'Afrique Occidentale Française" (Paris, 1912) now forms an invaluable introduction for whoever wishes to make researches into the geography of the region.

From the economic point of view a multitude of studies have recently appeared advocating the exploitation of French West Africa. These all agree on two points: (1) the necessity for the development of the productive capacity (particularly the agriculture) of the region and (2)—of even greater importance—the necessity for the perfection of an economic mechanism (*outillage économique*) capable of developing this productive capacity to the utmost and making its products available to the outside world. The importance of pushing forward enterprise along both of these lines was set forth during the war by Gustave Regelsperger in a broad presentation of the existing economic situation and future prospects of French West Africa (*Rev. des Sci. Polit.*, Vol. 36, 1916, Dec. 15, pp. 333–359) and, more recently, by M. Merlin, the governor-general, in a speech of December 29, 1919 (*Renseign. Colon.*, February, 1920, pp. 37–40), in which he vigorously urged, among other things, the promotion of large-scale farming, cotton cultivation, and the widest possible building of ports, railways, highways, and other public works.

From the standpoint of economic geography, Henry Hubert, one of the leading authorities on West African geology and physical geography, summarized the status of the colonies in an admirable article entitled "L'influence du facteur géographique dans le développement économique de l'Afrique Occidentale Française" in *Colonies et Marine* for October, 1920 (Vol. 4, pp. 599–620). This presents a brief sketch of the various physiographical features and their influence on economic conditions; it shows how relief and hydrography tend to impede communication between the coast and the interior; how botanic and zoölogical zones run in a general way east and west corresponding with the climatic zones and causing a range in the type of vegetation cover from the tropical forests of the south, through the savana belts of the Sudan, to the deserts of the north; and finally how the density of population is greatest in the intermediate savana belt. This leads to a discussion of the most advantageous means for the utilization of the geographic factors: river floods for irrigation, areas for the raising of cattle and goats, and means for making available the human resources of the country. We find here a strong plea for the reconstruction and sanitation of villages and for the improvement of the methods of transport and intercommunication as a means for preserving and fully utilizing the labor supply which these human resources represent.

The various subjects touched upon by Hubert are all dealt with in greater detail by others. From notes made during a six months' tour of investigation through the colonies, H. Cosnier presents a conservative estimate of agricultural possibilities (*Colonies et Marine*, Vol. 4, 1920, pp. 85–120); the future of cattle raising is treated in an optimistic vein by R. Chudeau (*La Géographie*, Vol. 32, 1918, pp. 196–199) who believes that the available area and conditions are almost as favorable to this industry as in Argentina; the prospects of introducing wool culture on a large scale are studied by Yves Henry in *L'Agronomie Coloniale* (quoted in *Colonies et Marine*, Vol. 3, 1919, pp. 313–314); and French medical science is interesting itself for economic as well as humanitarian reasons in the preservation of the population from scourges like the sleeping sickness (Jean Paraf: L'hygiène en Afrique Occidentale Française, *Colonies et Marine*, Vol. 3, 1919, pp. 786–788).

Most stress, however, has been laid on the urgency of carrying out public works on a large and comprehensive scale. An editorial on the subject in *L'Afrique Française* (December, 1920, p. 342) gives what we may regard as the gist of French opinion on this subject. Here it is asserted that the examples of Brazil and Argentina "permettent d'affirmer que l'essor du pays sera fonction de l'outillage dont il sera pourvu," and statistics are given showing that the commerce of French West Africa has uniformly followed the completion of great public works in an ascending curve.

Foremost among public works is the improvement of lines of communication, in regard to which there are two schools of thought. One school favors the extension and linking up of the lines now in existence; the other wishes to tap the resources of the Sudan and, in fact, of the whole region by the construction of a trans-Saharan railway and holds that this would obviate the necessity of building up a French merchant marine to rival the merchant marines of foreign countries in the shipment of African products. Various trans-

Saharan railway projects of the past are explained by Major Bettembourg together with a compromise scheme of his own (*Colonies et Marine*, Vol. 3, 1919, pp. 592–624, 666–679). French imperialists of militaristic leanings would like to see the entire colonial domain in Africa knit together by a network of railways built primarily for strategic purposes (the movement of troops to Europe) and only secondarily with commercial motives in view (Paul Bluysen, in *Colonies et Marine*, Vol. 3, 1919, pp. 106–117; Sallandrouze de la Marnaye, in *L'Europe Nouvelle*, quoted in *Colonies et Marine*, Vol. 3, 1919, p. 405).

A more conservative school is represented by the former Governor-General Angoulvant and by Lieutenant-Governor Antonetti of the Ivory Coast. From a careful analysis of the geographic factors of French West Africa, physical, vegetal, and human, Angoulvant (*Colonies et Marine*, Vol. 4, 1920, pp. 531–563) came to the conclusion that the best interests of France and of the colonies themselves can be served only if plans for the construction of railways are made after a thorough consideration of all these factors and their interrelations. The determination of the routes and of the areas to be opened up must depend on a variety of circumstances such as: accessibility of the sea and of a port; density of population; topography; potentiality of a given area to increase its productive capacity, etc. On the basis of such considerations Angoulvant elaborates a plan out of which, were it once put into effect, would evolve the entire future economic development of French West Africa. The evolution of the human geography of an undeveloped country from a primitive state into one of relatively complex organization generally procedes more or less at haphazard. Angoulvant's plan, were it adopted, would direct this process along channels worked out by science; it would mean the putting into effect of applied science (here applied geography) on a scale of almost unparalleled magnitude.

Though they differ as to details, Angoulvant, Antonetti, and the other representatives of the conservative policy are in agreement in the general outline of their plans for the building of railways: as railway freights are high in comparison with ocean freights, lines should be so constructed that they will connect interior centers of production with the seaboard by the shortest possible routes. The railway now in existence connecting the upper Niger with the Senegal and with Dakar should be improved; the lines, now running but a few hundred miles into the interior, in French Guinea, in the Ivory Coast, and in Togo and Dahomey should all be extended in order to reach the thickly peopled savana regions of the Sudan; ultimately they should all be linked together by a system of railways parallel to the coast and by the improvement of navigation on the Niger and Senegal Rivers. Of these various projects, the one of foremost importance is the extension of the existing line through the Ivory Coast to Buake so that it will reach Wagadugu in the newly constituted colony of Haute Volta. This portion of the Sudan, of all of French West Africa, combines the greatest density of population with the greatest possibilities of future productive development, and it will find an easy approach to the sea through the Ivory Coast by a railway which will make available to the other colonies its wealth in labor resources.

A corollary to the building of railways is the improvement of ports. As transfer charges without adequate dock facilities are almost prohibitive, every effort should be made to deepen the harbors and to improve the mechanism of transshipment. The port that deserves immediate attention above all others (except, perhaps, Dakar) is the one destined to be the terminus of the Ivory Coast Railway, i.e. either Grand Bassam or Abidjan. In the August, 1919, number of *Colonies et Marine* J. C. Paulme urges that the French government take speedy action to make this port available for vessels of large draft and to perfect its dockage facilities if it does not wish to see the commerce of the Sudan drawn away over the newly constructed railway in the neighboring British Colonies of the Gold Coast and Ashanti.

AFRICA

The Hydrographic History of Lake Tanganyika. Tanganyika is a lake to intrigue the geographic imagination. It lies in a remote region where physical phenomena have been developed on a grand, a "spectacular" scale—the great *Graben*, the great massif of Ruwenzori, the volcanic Mfumbiro, "Mountains of the Moon." Tanganyika itself is mysterious in its great deeps (over 1,400 meters, a lacustrine depth exceeded only in Lake Baikal), its peculiarities of discharge, and the strange fauna that led Moore to pronounce it a *Reliktensee* (to the argument opposed to this theory a recent addition is made by Louis Germain: Histoire océanographique des lacs de l'Afrique orientale, *Bull. l'Inst. Océanogr. No. 369*, 1920). These aspects are touched on by R. Theeuws, Chief Engineer of the Colony

of the Belgian Congo, in a series of articles in *Le Mouvement Géographique* (December 5 and 19, 1920; January 30, March 6, April 10, May 8, 1921) that envisage the past, present, and future of the lake. The remote past is dealt with lightly, being treated as it bears on the recent past and the most important event in the history of Tanganyika as it concerns us today—the opening of the Lukuga outlet.

Less than 50 years ago Tanganyika was a basin of interior drainage. At a date fixed by Theeuws as 1878 a breach was made in the basin through the Lukuga valley, since which *débâcle* the Lukuga has functioned as effluent of the lake. By some the phenomenon has been ascribed to river capture. Theeuws finds it simply overflow of the lake, gradually filling through excess of water gained by precipitation in the basin over water lost by evaporation. He also denies that the Lukuga has acted as an intermittent outlet.

We know something of Tanganyika in 1840 through Arab reports. Burton and Speke were the first Europeans to sight the lake (1858). Livingstone saw it in 1869 and again in 1871 when Stanley found him at Ujiji. Stanley again saw the lake five years later. During this period its waters were rising at a mean rate estimated by Theeuws as 18 centimeters a year. He also estimates the highest level of the lake, when the *débâcle* of 1878 occurred, as 782 meters above mean sea level. Physiographic interest concerning the *débâcle* is concentrated on the outlet. M. Theeuws apparently is in agreement with the theory that the primitive Lukuga valley antedates the formation of the lake, being part of an east-west flowing river He discusses sympathetically, however, Stanley's hypothesis of the former existence of two lakes, the southern and higher of which drained westward through the Lukuga until a diastrophic movement broke down the barrier between the lakes (the present lake is characterized by two basins separated by a submarine bar covered with 250 meters of water) and precipitated the southern waters into the northern lake, causing the abandonment of the Lukuga. However this may be, the primitive Lukuga, which had evidently accomplished much erosion in approximating a graded course, was left dry except for the waters of tributary torrents. These filled up the valley floor and, with the swamp vegetation that throve thereon, built a barrier, estimated to be 14 meters thick, at a distance of 16 kilometers from the lake. When Stanley saw it in 1876 he predicted the imminence of the *débâcle*. It appears to have begun with the April-May rains of 1878, though probably attack on the barrage by seepage and the work of wind and wave in flood had been in operation for some years previously.

The year before 1876 seems to have been a time of rapid rise in the lake. A similar condition is reported for Victoria Nyanza (H. G. Lyons: The Physiography of the River Nile and Its Basin, Cairo, 1906). By 1888 the *débâcle* appears to have been completed, and the lake attained what may be termed a stage of relative stability. Since then the level of the lake has fluctuated in sympathy with meteorological variations. A minimum stage was reached in the middle nineties. From 1912 to 1917 there was a rapid rise, since when there has been a fall. Difference between the maximum and minimum stages amounts to some 2 meters. This, in conjunction with the annual variation of high and low waters and the imperfect function of the Lukuga as a regulator, is a matter of importance as regards utilization of the waters of the lake.

M. Theeuws briefly discusses the utilization for hydraulic force, for irrigation, in connection with port construction on the lake, and for a far-reaching project, the improvement of the fluvial régime of the Congo system. Navigation on the shallow waters of the Upper Congo streams is seriously impeded during the dry season. The building of a barrage at the outlet of Tanganyika would permit of a considerable control by the use of flood waters during the low stages of the Lualaba, August to November. Before such a project can be carried out more data must be collected, and such will be welcome from the scientific as well as the practical standpoint. Up to the present, precise observations on the hydrography of Tanganyika have been scant indeed. Observations of this category and on the topography of the lake shores and the Lukuga valley, as well as the general region, are necessary for reconstruction of the past of the lake. As M. Theeuws says, speculations on the history of Tanganyika rest at present on few facts and many hypotheses.

The Desiccation Theory of Northern Africa. In "The Encroachment of the Sahara on the Sudan" (*Journ. African Soc.*, Vol. 20, 1921, pp. 174–185; 259–269) E. William Bovill summarizes the chief arguments relating to the desiccation theory of northern Africa. While it is generally agreed that northern Africa has witnessed climatic oscillations in the past, there is disagreement as to the present trend. Naturally it is in the critical areas bor-

dering the desert, especially the Sudan, that we look for evidence. Gautier, who believes that the desert is gaining on its northern fringe, thinks that the contrary is taking place on the Sudanese edge. Chudeau is of the same opinion. He regards the present as a period of increasing humidity in French West Africa, his strongest argument being the fixation of dunes. On the other hand, Hubert, also an eminent geologist, finds different interpretations and contrary evidence in the same region. He has gone into the matter more fully than any other observer. A detailed statement of his painstaking investigations has recently appeared ("Le dessèchement progressif en Afrique Occidentale," *Bull. Comité d'Études Hist. et Sci. de l'Afrique Occidentale Française*, 1920, No. 4, pp. 401–467). In Senegal in recent years rivers have ceased to flow or have become increasingly brackish, wells have failed, desert sands have advanced, crops have failed. M. Hubert believes that, while there are doubtless several contributory factors, diminution of rainfall is the basal cause.

Unquestionably man has been an agent in part responsible for local desiccation in northern Africa as elsewhere. It seems to be a law that in the desert and along its edge abandonment of cultivation means that the desert will creep in just as in a more humid region destruction of the forest is indirectly, if not directly, a cause of diminished humidity. Of the gain of the Sahara on its interior oases and fertile fringes there are innumerable instances from the decadence of Roman Africa to the recent decline of prosperity in the Fezzan region of Tripoli. The precipitate withdrawal of the Italians from Fezzan on entry of the war was followed by nomad invasion from the desert; wells were filled up, palm groves and gardens destroyed, and the cultivator was hopelessly discouraged.

It is a question how far movement of the restless tribes and their relation to the sedentary peoples is effect rather than cause of declining prosperity. Mr. Bovill in particular takes up the case of the peoples of Sokoto province, Northern Nigeria. The population is unevenly distributed. "In the south there are well-watered areas which are only sparsely inhabited. But in the more arid north, owing to immigration from French territory, every square yard of cultivable land is occupied." Except to careful and continued observation the southward movement may escape notice (quoting the Resident), "First, because the population is in layers. Where Habe farmers have been driven out by drought and diminishing yields, the Fulani or Adarawa, with their live stock and lighter methods of agriculture, are glad to take their place. . . Again, when the grazing becomes too poor for the cattle, the Buzai and Tuarek, with their sheep and camels, are pleased to come in. The second cause of this movement escaping notice is that it is so gradual and never for any great distance at a time. The community does not rise in flight like locusts and arrive *en masse* in a new area. It is rather the continued hopping from field to field, from district to district, devouring all as it goes. . . The rearguard of the swarm has fortunately not yet reached this province. They are the sedentary Tuarek and Buzai on our northern borders. Beyond them are the nomad Tuarek of the desert."

It is interesting to note that a similar movement is reported from the southern part of the continent. Professor Schwarz in his book, "The Kalahari, or Thirstland Redemption" (see below) bases this deduction on an analysis of census returns made by W. M. Macmillan ("The South African Agrarian Problem, and Its Historical Development," Johannesburg, 1911). There has been a decline in the central sections of the Union and a drift towards the northern and eastern Transvaal and still farther north. Possibly this is analogous to the decline in population in Kansas and adjacent states in the mid-nineties, when a series of dry years followed years of good rain, and may simply represent the relative instability of settlement in a pioneer country. In northern Africa, too, the recent evidences of increased dryness may be simply short-period fluctuations. But whether aridity be periodic—long or short—or secular, it is not, as Mr. Bovill points out, a mere academic question. In such a region as the Sudan, where nomad and sedentary peoples live side by side in a condition of unstable equilibrium, it is a matter fraught with political significance.

The Redemption of the Kalahari. The theory of progressive desiccation of Africa has one of its most active exponents in E. H. L. Schwarz of Rhodes University College, Grahamstown, South Africa. Professor Schwarz has particularly devoted his attention to the southern part of the continent where desiccation—of which there are numerous indications—has not progressed as far as in the north and where, according to him, the disastrous consequences can be remedied. The author's numerous writings on the subject have been brought together in book form under the title, "The Kalahari, or Thirstland Redemption" (Cape Town, 1920), while a still more recent discussion, "The Control of Climate by Lakes,"

has appeared in the March number of the *Geographical Journal* (Vol. 57, 1921, pp. 166–181).

Professor Schwarz's proposed remedy is bold and original. He is not going to accomplish the redemption of the southern African deserts by the ordinary methods of irrigation. Instead, he proposes to change the climate. So far his ambitious project has appealed more to the masses of South Africa than to the scientists. Yet if one is sceptical concerning the ultimate accomplishment of the Kalahari scheme, it must at least be admitted that only theories oppose the consummation of it and not laws. In other words there is a chance that Professor Schwarz is right.

The steps in the argument are:

1. The desiccation of Africa is due to the draining of the continent by head-stream erosion and river piracy.

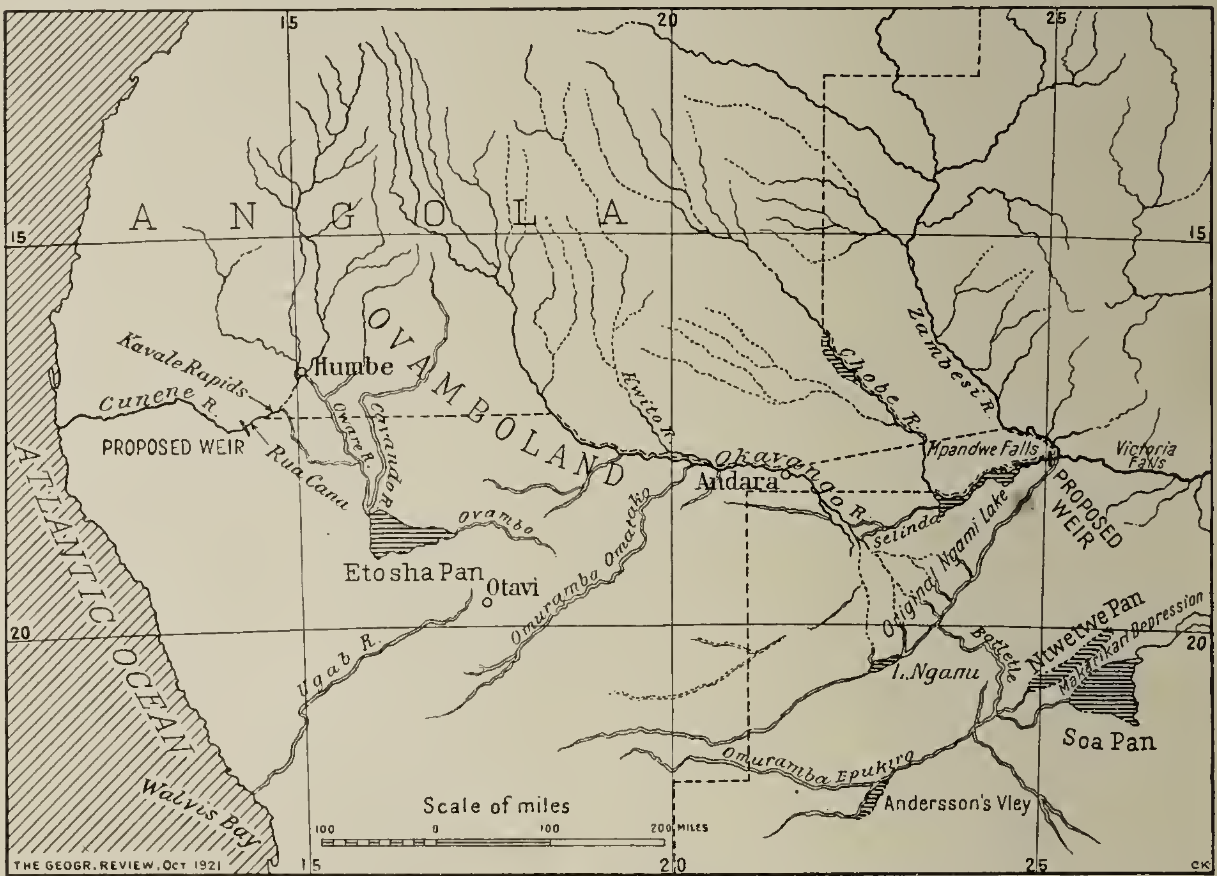

FIG. 1—Sketch map of the region included in Professor Schwarz's scheme for the redemption of the Kalahari. (On the above map for Cunene read Kunene.)

Scale approximately 1:15,000,000.

2. With desiccation irrigation is a losing venture or a temporary expedient, since an increasing amount of the water will be lost in evaporation and a constantly decreasing land area only can be utilized and then only by chemically treated soils in order to avoid brak (alkali).

3. The desiccation will be halted by the artificial prevention of river piracy and by the damming of such spillways as lead the waters from the interior to the ocean.

4. Then will be recreated in the interior of the Kalahari a great interior sea which will act as a humidifier of the atmosphere of the area and thereby increase the rainfall.

Concerning the first of these points, Professor Schwarz attempts to show that the topography of Africa is an underlying cause of the extensive aridity. The high areas of the continent, many of them divides, being adjacent to the coast result in short and swift coastal streams and long and more sluggish interior streams. The more active coastal streams have in many instances tapped the interior streams and turned water which in times past entered the interior back to the ocean. For example, some of the headwaters of the Niger have been captured by the Volta; and other headwaters are threatened by the Bandama River. It is confidently asserted, with ample evidence, that Ovamboland was at one time more moist than now and that water stood in the depression of Etosha Pan continuously. The desiccation of this area has been caused, according to Schwarz, by the coastal stream,

the Kunene, tapping the interior Kunene (formerly an independent stream flowing towards Etosha Pan) at Kavale (Kambele) Falls and diverting the waters from Ovamboland; and on the east further desiccation of the area was effected as a result of the tapping of the interior streams by the Zambesi River at Victoria Falls.

In the second place, irrigation alone is not successful in redeeming these areas, (1) because the areas under irrigation are so small in comparison with the vast spaces of arid land that the desert conditions are not relieved, (2) because, in the dry air which obtains, water is quickly brought to the surface and the soil is thus rendered brak, and (3) because by the silting up of the reservoirs the amount of storage space is rapidly diminished. Professor Schwarz uses as illustrations of these points, first, Van Wyk's Vley and, second, the Bloemfontein Reservoir. Van Wyk's Vley, opened in the late eighties, is now largely abandoned because of brak, and in the area still operated an earning capacity of less than two per cent on the capital invested is realized. The Bloemfontein Reservoir, which was built to hold a three years' supply of water, was actually found to have in the drought of 1919 less than a six months' supply as a result of the rapid silting and filling processes.

The prevention of the desiccation and the remedy for the failures of irrigation are easily accomplished according to Schwarz's plan by reversing the process of stream capture and turning the waters again to the interior. In the case of Ovamboland this will be accomplished by building a dam or weir across the Kunene River above the "small cataracts" (Kavale Rapids) and diverting the waters into the abandoned channels which lead to the dried-up basins of Ovamboland and Etosha Pan. A second weir will be built across the Chobe just above its confluence with the Zambesi by which its waters will be directed southwards in old channels and, with the waters of the Okavango and possible overflow from Etosha Pan, will form a lake in the Makarikari depression in which lie Ntwetwe and Soa Pans. The estimated areas of water in Etosha Pan and Makarikari Lake will amount to 20,000 square miles, and there will be 10,000 square miles of irrigated land to which can be added a further 70,000 square miles in Ovamboland restored to fertility.

So far the scheme is well within the bounds of probabilities, though the lakes thus created may not be so large as anticipated and may not be constantly maintained. The next point in the argument is more difficult and cannot be so readily accepted. With the exposure of this great surface of water in the desert evaporation will be increased until the air becomes normally more humid; and this in turn will increase the rainfall, and the flow of the streams will be correspondingly augmented. This is best stated in the case of Lake Chad.

"A large portion of the drainage into Lake Chad has been cut off by the boring headstreams of the Benue, and every year these, having higher gradients than the tributaries feeding the Chad rivers, are claiming more and more territory. If evaporation from the water surface in Lake Chad is sufficient to give half an inch of rain in the Sahara, this has no appreciable effect on the country; were the area ten times as great as it apparently was formerly, five inches of rain would make a distinct change in the country, and in addition, the air being moist while the evaporation was proceeding, rain-laden clouds blowing in from outside would be reinforced, and additional rain would be secured in that way."

Professor Schwarz's scheme has been criticized on meteorological and engineering grounds. In particular, it has been challenged by F. E. Kanthack, Director of Irrigation for the Union of South Africa, who asserts that the requisite amount of water cannot be furnished —at least in the case of the Kunene River. This is in part admitted by Schwarz, who states that 5.5×10^{12} cubic feet of water will be required (for the entire scheme) while he estimates the annual flow of the tributary streams as 2.5×10^{12} cubic feet. His scheme stipulates that "this water will remain in the country and result in increased precipitation, so that next year there will flow into the lake 2.5 units of new water, and an appreciable quantity of water returned to it from last year's supply." Mr. Kanthack (who has recently acted on the commission for field investigation of the disputed Angola-Southwest African Protectorate boundary) describes the physical character of the Kunene River section in some detail in "Notes on the Kunene River, Southern Angola" in the May number of the *Geographica Journal* (Vol. 57, 1921, pp. 321–336).

A second line of criticism considers the increasing depth of silt over Ovamboland as a cause of the disappearance of the waters and a reason for less flow than formerly. In the same connection this silt would have a material effect in reducing the amount of water in the catchment basin of the proposed lake.

More serious and at the same time less confident criticism is hurled against the humidification expectations of Professor Schwarz. The examples cited to maintain his argument

are exceedingly weak, for which he is not particularly to blame as no case of complete experimentation and research along these lines is available. The natural illustration of the Salton Sea, quoted by C. E. P. Brooks in an interesting review of Professor Schwarz's book (*Quart. Journ. Royal Meteorol. Soc.*, Vol. 47, 1921, pp. 72–74) is on a considerably smaller scale. It is worth noting that a similar solution for relieving the aridity of northeastern Brazil has recently been proposed ("O problema das seccas do Nordeste resolvido por Luiz Mariano de Barros Fournier," Rio de Janeiro, 1920, reviewed in the *Meteorol. Mag.*, Vol. 56, 1921, pp. 46–47).

In general, however, it is the opinion that the creation of such water areas as Schwarz proposes would not produce enough humidity of the atmosphere to obtain the results predicted. Here is a line of investigation that must be pursued. Whether Professor Schwarz's scheme materializes or not, presentation of the project has brought to light a number of lines for investigation which ought to attract attention.

R. M. Brown

AUSTRALASIA AND OCEANIA

Modifying Climate by Human Agency in Southeastern Australia. To the argument on possibilities of modifying climate by human agency discussed above a further contribution is made by E. T. Quayle, meteorologist to the Australian Commonwealth, in the May issue of the *Proceedings of the Royal Society of Victoria* ("Possibilities of Modifying Climate by Human Agency, with Special Application to South-Eastern Australia"). Mr. Quayle is of the opinion that under the natural climatic conditions of southeastern Australia increase of the "evaporation surface" will normally be accompanied by increased rainfall, in demonstration of which he presents actual measured evidence. In New South Wales and South Australia near the northwestern border of Victoria large areas formerly under Mallee scrub (dwarf eucalypts, which transpire little) have been brought under grass and cereal cultivation, a better evaporation surface. Data from meteorological stations in such areas compared with those from unimproved areas show an increase in the amount and proportion of the spring (the critical) rainfall with cultivation. Figures for the yearly rainfall for irrigated areas indicate a similar response. A study of the monthly rainfall for 1919, a year of record irrigation, shows increased rainfall over irrigated districts and in their lee. It was in the last decade that the greatest advance was made in irrigation and cultivation of the Mallee. The mean rainfalls for this period compared with that of the 30-year period, 1885–1914, are above the general average for the improved land, whereas for other areas the figures for the last decade are below the average.

Mr. Quayle, however, plainly states that the question of improved rainfall is a matter of delicate balance. The artificially increased evaporation must bear an adequate relation to the normal humidity of the upper air. "It is hardly necessary to remark that it is in rainy weather that the principal additions to the rainfall must be made by local evaporation. Under generally anticyclonic conditions, as in some of our great drought years, the rains must largely fail." It is one of the critical points in the practicability of such a project as Professor Schwarz's Kalahari scheme (see above).

WORLD AS A WHOLE AND LARGER PARTS

The Southern Ocean and Islands East to South of Cape Horn. The Southern Ocean has long been notorious for its dismal raw climate with but infrequent breaks in the cloudy skies and succession of storms. What can attract the white man to the bleak Falkland Islands, South Georgia, and South Shetlands? On the leeward (drier) portion of southern Patagonia and Tierra del Fuego (south of 50° S.) sheep raising is practically the only occupation other than fishing. The Falkland Islands (area 6,500 square miles), 250 miles to the east, similarly are noted for sheep raising and are the home of some 2,000 people, mostly Scotch shepherds. South Georgia, 900 miles still farther east and in the same latitude as Cape Horn, is too cold and stormy for sheep raising and, therefore, is all but uninhabited except in the lighter slightly warmer months when most of the whaling is done. The western slope of this island of 1,600 square miles is permanently snow-covered down to 2,000 feet above sea level, and all valleys are filled with glaciers. In marked contrast the eastern slope, swept occasionally by warm, dry *föhn* winds down from the mountains, has no accumulation of snow even in winter. A similar though less marked *föhn* wind occurs on the eastern

side of East Falkland. An ice-laden current makes both the Falklands and South Georgia appreciably colder than South America at corresponding latitudes. The South Orkneys (see "Climate of the South Orkneys," *Geogr. Rev.*, Vol. 1, 1916, p. 305), South Shetlands, Graham Land, and the volcanic South Sandwich Islands are generally ice-covered and ice-enclosed and practically useless even as shelter for whalers.

Detailed, accurate meteorological records for 13 years at Cape Pembroke (eastern cape), East Falkland, and for 11 years at Grytviken, Cumberland Bay, South Georgia, and other broken records have been summarized recently by C. E. P. Brooks in a monograph which may be used as a model for thorough and effective presentation of climatic data ("The Climate and Weather of the Falkland Islands and South Georgia," *Geophys. Memoirs No. 15*, Meteorological Office, London, 1920, pp. 95–146). The data for each element—pressure, temperature, relative humidity, cloudiness, sunshine, precipitation, fog and winds—are presented by months and hours of the day in tables and diagrams.

An interesting feature in the storminess is that it is no less in summer than in winter, while spring and fall are even stormier. Contrary to the seasonal shifting of wind and storm belts in other parts of the world, southern cyclones follow tracks farther from the pole in summer than in winter. The reviewer thinks that this may explain in part the lack of any summertime let-up in storminess. The procession of cyclones passing on the south results in northwest to southwest winds almost exclusively at Cape Pembroke and Grytviken. The temperatures are those of a subarctic marine climate at Grytviken, with a small annual range (February 43.5° F., July 27.9° F.) and a small daily range (12.2° F.). Cape Pembroke has a smaller range and a temperature averaging about 7° F. higher. Hot weather and extremely cold weather never occur, the absolute extremes at Grytviken being −2.6° F. and 79.7° F. The relative humidity and cloudiness at Cape Pembroke are high throughout the year. The lack of sunshine is evident from the fact that only in the three midday hours of February does the sunshine exceed 50 per cent of the possible. In June it is not as much as 30 per cent even at midday. The rainfall (about 25 inches at Port Stanley and 56 inches at Grytviken) is moderate and evidently much less than on the western parts of the islands. At Port Stanley the maximum, in May, is about double the minima, in October and January; and at Grytviken the maximum, in January, is about double the minimum, in September. At Cape Pembroke precipitation occurs on the average of two days out of three (253 days a year), and snow 54 days. At Grytviken precipitation days are 196 and snowfall days 109. Snowstorms are fairly frequent even in summer. Days with fog average 54 a year at Cape Pembroke and 25 at Grytviken. Strong winds prevail two-thirds of the time at Cape Pembroke.

The weather of this out-of-the-way region is doubly of interest. The meterorologist now appreciates the truth of Maury's conclusion of more than 60 years ago, when, referring to the Southern Ocean, he said, "It is a reservoir of dynamic force for the winds, a regulator in the grand meteorological machinery of the earth." R. C. Mossman says that Antarctic weather conditions may be used as a factor in predicting (1) the rains and height of rivers in Argentina, (2) the monsoonal intensity in India, and (3) the temperature of Kimberley, South Africa. The geographer views the inclement weather as the prime factor which limits the industries of this region essentially to whaling, sealing, and fishing—agriculture being impossible. In the waters of the dependencies of the Falkland Islands is located the world's greatest whale fishery, with an annual catch which in one year of the past decade rose to nearly 12,000 whales, valued at about £2,000,000. The nearer the southern ice pack the more numerous the whales, apparently because the more abundant the food (shrimps largely) The whalers, therefore, must endure most unfavorable weather and seas and in summers with much pack ice find their usual hunting grounds inaccessible. Considering the almost continuous rough weather and the practical lack of ice-free land and harbors, it is surprising that such a large industry can be prosecuted successfully (compare the note on whale fisheries of South Georgia, *Geogr. Rev.*, Vol. 6, 1918, pp. 286–288).

But there are possibilities for more than doubling the economic resources of this otherwise useless region. Fur seals can perhaps be re-established to replace the herds exterminated in 1821 and 1822, in which years Weddell estimates that 1,200,000 skins were taken from South Georgia and 320,000 from the South Shetland rookeries. Fisheries may be established to supply at least a portion of the 67,000 odd metric tons of fish, valued at about $15,000,000 imported into Argentina, Uruguay, Brazil, and Chile (statistics of 1913, 1914, or 1915). The waters of the Dependencies must be teeming with fish, for how otherwise could the tens of thousands of sea elephants and millions of penguins live here?

In 1917 an appreciation of the imminent danger of exterminating the whales led to the formation of an Interdepartmental Committee on Research and Development in the Dependencies of the Falkland Islands. The report of this committee, with voluminous appendixes, bibliography, and very complete index, was recently published (H. M. Stationery Office, London, 1920). It covers in detail the hydrography, geology, meteorology, flora, fauna, history, industries, and possibilities of the region south of 50° S. in longtitudes 20° to 50° W., and south of 58° S. in longtitudes 50° to 80° W.—the region southeast and south of Cape Horn. More than half of the publication treats in detail of whaling and the biology of whales. The committee urges sending a fully equipped scientific expedition, with biologists, meteorologist, geologist, and surveyors in two ships. Perhaps three years would be required to complete a satisfactory study of the life histories, habits, and migrations of whales, seals, and other fauna of commercial value and to make a hydrographical survey of the region.

Charles F. Brooks

HUMAN GEOGRAPHY

Travel As a Form of Human Enterprise. Enormous as has been the number of books of travel, of tourists' guides and travelers' handbooks, of collections of voyages, of histories of exploration and discovery, relatively few have dealt with the history of travel. Particular travelers and their expeditions have received much attention, but there is a broad and fresh field for research and historical synthesis in the history of travel as a form of human enterprise.

The motives that have induced men to leave their homes and take to the road have varied greatly with the ages, though war and the search for commercial gain have been perennial. During the long centuries of peace under the Roman Empire, pleasure traveling was indulged in for much the same reasons that prevail at the present time. Historic spots were visited, and the more striking natural curiosities were sought out—Etna, the currents of the Euripus, famous groves, grottoes, etc. The Romans were also lovers of nature in her milder aspects (see Sir Archibald Geikie: The Love of Nature Among the Romans, London, 1912), but there is abundant evidence that they had little or no eye for the wilder beauties of mountain scenery. In a little book entitled "Travel Among the Ancient Romans" (Boston, 1920) Professor W. W. Mooney, of Adelphi College, has recently gathered together many interesting data on Roman roads—the extent of travel, animals, equipment, ships, and vehicles used, with an enlightening chapter on Roman inns. Mooney does not claim to contribute much that is original, and his book in no way supersedes Friedländer's classic and far more penetrating discussion of the subject in his "Roman Life and Manners." "Travel Among the Ancient Romans," however, is a handy and readable reference book which renders conveniently available in cheap form information that would otherwise be difficult to obtain.

In the Middle Ages pilgrimage, war, commerce, and diplomacy were about the only motives that displaced men from their accustomed haunts. On travel during the later medieval period there is no more delightful book than Ambassador Jusserand's "English Wayfaring Life in the Middle Ages (XIVth Century)" which has recently been published in a new and enlarged edition (New York, 1920). This fascinating and profound study of life on the roads and in the taverns of fourteenth-century England first appeared in English in 1889 and ever since has enjoyed a well-deserved popularity. The fourteenth century was a time when the roads of England swarmed with wayfarers of all kinds: merely to quote Jusserand's chapter headings, with "herbalists, charlatans, minstrels, jugglers, messengers, merchants, pedlars, outlaws, wandering workmen, preachers, friars, pardoners, and pilgrims." "At a period when, for the mass of mankind, ideas were transmitted orally and travelled with these wanderers along the roads, the nomads served as a link between the human groups of various districts." On the highways and in the inns the untutored man of the age gathered what little he could learn of geography.

With the Renaissance traveling for pleasure began again. The complete and well-rounded man was the ideal of this great age, and travel was thought to be an essential aid toward the attainment of that ideal; the travelers of the Renaissance were interested above all in man and his works. Young Englishmen in the days of the Tudors and Stuarts frequented the Continent to learn foreign languages and customs and to make the grand tour held to be so vital a part of their education. Clare Howard discusses this aspect of the history of travel in an entertaining book, "English Travellers of the Renaissance" (London, 1914).

The Romantic movement of the eighteenth and early nineteenth centuries ushered in a new epoch of pleasure traveling. Probably for the first time great numbers of men began to appreciate the beauty of wild scenery and of mountains (Francis Gribble: The Early Mountaineers, London, 1899; and W. W. Hyde: The Development of the Appreciation of Mountain Scenery in Modern Times," *Geogr. Rev.*, Vol. 3, 1917, pp. 107–118). Regions that in earlier days were shunned as hideous and horrible now become the haunt of a new kind of pilgrim, the mountaineer.

Dr. Mill on Regional Geography. "Hasty generalization," as an eminent geographer has recently said, "has long been an evil in geography." General geography can rest firmly only on a basis of clearly established facts; in other words it is dependent on the well-determined facts and relations of regional geography. Herbertson's great contribution to geography was his insistence on regional study. So Dr. H. R. Mill reminds his audience in the Herbertson Memorial Lecture for 1921 ("The Value of Regional Geography, an Address before the Geographical Association of Great Britain," *Geogr. Teacher*, Vol. 11, 1912, pp. 7–19). Dr. Mill himself has long insisted on the need for regional study. Twenty-five years ago he advocated the preparation of a detailed geographic description of the British Isles and drew up a scheme for its execution based on the Ordnance Survey map sheets 1 inch to 1 mile (*Geogr. Journ.*, Vol. 7, 1896, pp. 345–365). Later an example of the proposed treatment was given in "A Fragment of the Geography of England" (*Geogr. Journ.*, Vol. 15, 1900, pp. 205–227 and 353–378). The scheme, as Dr. Mill had foreseen, proved only a "seductive dream"; but could it have been carried out as planned it would have been virtually completed when the war broke out, and "the total cost could have been saved ten or a hundred times over in the prevention of waste on aerodromes on impossible sites, or attempt to cultivate land unsuited by its nature for agriculture, and by the utilization of water power to conserve coal; to mention only a few of the applications to which it might have been put."

In his address Dr. Mill illustrates the significance of regional study through the phase with which he has been most intimately connected—the rainfall map of the British Isles. At the time of Dr. Mill's retirement in 1919 about half the map (average rainfall on a scale of 2 miles to the inch) had been completed. Its construction has involved the careful study of many data and a vast amount of experimentation in mapping. In the course of the work general principles governing the relation of configuration to rainfall have emerged. Added experience confirms the principles and gives the hope of determining quantitive as well as qualitative values. The rainfall map has a practical application in the natural distribution of surface water (river basins), whence one passes to questions of its control and utilization to what Dr. Mill calls a "water geography" (memoirs on river basins), a specialized form of regional geography.

GEOGRAPHICAL REVIEWS

On Underground Water in Limestone Regions

E. A. Martel. **Nouveau traité des eaux souterraines.** 838 pp.; maps, diagrs., ills., bibliogr. Librairie Octave Doin, Paris, 1921. 10 x 7 inches.

Everyone who is familiar with the history of the exploration of caves knows the name of E. A. Martel. He is probably the most indefatigable and courageous student of speleology. For thirty-eight years, as he constantly reminds the reader, he has devoted a large part of his time to the detailed study of caves in many parts of the world. The Pyrenees, Central France, the Balkans, and the Juras have been his chief fields of study. In this book he has gathered together the best of his material and has arranged it in a systematic manner that greatly increases its usefulness. But he has included descriptions of almost innumerable caves, and there are many thousands of references to villages and town and streams whose names are spelled differently on different maps, and many of the names cannot be found in the gazetteers. Under these circumstances it is nothing short of deplorable that the publishers have not supplied an index.

The work of Martel has involved a quite remarkable collection of facts regarding underground conditions, and he knows the literature thoroughly. His detailed appendixes and bibliographies are virtually complete except for American references during the past ten or twelve years. Three hundred and eighty-two illustrations, more than half of them diagrams of caves and underground channels, furnish the reader with an unparalleled quantity of facts.

But it is on the side of facts alone that the book can be commended because of two very serious defects which it seems worth while to point out in order that students of his book may not be led astray. Though the title would lead one to suppose that the treatise dealt with underground waters in general, as a matter of fact it is chiefly *a treatise on underground water in limestone regions*, and it is in some respects unfortunate that this limitation of the title was not included in it. The treatment of underground waters in other than limestone regions is distinctly superficial. And it is so casual and incomplete that from reading it one might suppose that the land surface of the earth was almost everywhere underlain with limestone and that the normal occurrence of underground waters was in fissures and other openings in limestone at a considerable depth.

A careful reading of the book leads to the conclusion that the contents fall in four classes: (1) a setting forth of the author's controversies with other students, whether those controversies relate to ground water or not, (2) the author's method, which is to deny a rival explanation and assert one's own, or at the most to point to one's thirty-eight years of experience and let it go at that, (3) the best examples of caves with very clear sketches and detailed descriptions, and (4) a profound misconception of many physical theories of land-form origins and particularly of the limits that the authors of those theories themselves have recognized and set up. He goes into the question of ice erosion, reviews the several opposing opinions or theories on the subject in a quite superficial way, and then brands opposing views as "exaggerations of the theory of erosion by ice" (p. 439). After the greatest possible exaggeration of those physical processes that he has become most familiar with through a lifelong study of caves, he recognizes that there are a few other regions on which these processes may not be so important. In the face of this recognition he does not alter his exaggerated statements but permits them to stand, merely following them with curiously contradictory remarks of an opposite kind that appear to be merely anchors to windward. When he speaks of his own theories it is as if he were not discussing a theory, but truth; when he discusses opposing views he treats them as theories, forgetting that he himself starts with a fixed idea, for example, that practically all valleys are affected by fissures. Much controversy appears to be responsible for the introduction of an element of war psychology. Those who disagree with him have too closely followed the German method, which is to have preconceived theories; whereas the French method is that of Plutarch—to work from the facts and derive clear hypotheses "that reveal the true light"! The reader should not hastily conclude that in this matter he rails only at Germans. Frenchmen and Englishmen and Americans who differ from him are *all* classed as followers of the German method. Natur-

ally this leads him to a general denunciation of German scholarship and the Germans, those "pedantic protagonists of false hypotheses" (pp. 67, 147, 450, etc.). The author must take a grand fling at all of his old adversaries. His book on ground waters is his last great opportunity. Scouting the armchair scholar and the followers of "German methods" (including Lugeon, de Martonne, de Margerie, and Davis), he makes caves the central idea of his creed. He revives old hypotheses which many have forgotten or cites in vigorous terms facts that no one in the world denies.

Many men of straw are set up. He thinks the word *karsting* connotes Cretaceous rock, on the one hand, and a geographical locality, namely the Karst of the eastern Adriatic lands on the other, and he would therefore substitute the phrase "phénomènes du calcaire," (pp. 213 and 214). A few sections in the early part of the book are devoted to a condemnation of the idea of the fluvial cycle, but when we reach the evidence in support of his views we find that it wholly lacks vitality. Newberry, Dana, Powell, Gilbert, Dutton, and Davis of the "American school" have exaggerated the facts of the fluvial cycle because of their too limited knowledge of fields of rapid erosion, like that of the Colorado! Side by side with his condemnation of this state of affairs there is the recognition of the great importance of Mammoth Cave; and no one but Martel (according to himself) has recognized its real mode of formation, except possibly Shaler to a certain degree (p. 36)! There are strictures on the use of the word "cycle," and a general condemnation of Slichter's work on ground water, though in later pages he returns to Slichter for many a commendatory statement.

If he finds a steep-walled valley with a relatively straight course, the valley occupies a fissure. Because the trend of joint planes in the rock on gorge walls corresponds to that of the valley for a short section, that is sufficient proof that a joint or other crack controls the course of the river—and the implication is that it did so throughout its development (p. 47). Many other writers would not deny the influence of fissures in controlling the initial courses of valleys, and certainly no one would deny that influence in a limestone region; but he is thinking of the merest origins, and the general student thinks of all the successive changes in river curves in the fashioning of the valley wall, changes that are closely interlocked in their influence on the final result. In short, the author's view is everywhere narrow, and the student of land forms must take a much broader view. Martel finds U-valleys that have not experienced glaciation and V-valleys that have, and that to him is the very essence of proof of the incapacity of ice to erode! He does not stop to inquire what kind of a U-valley it is, nor does he illustrate the U-valley that he has in mind, nor does he say in what regions the U-valleys occur that have not been affected by ice. His method is that of the old-style logician, not that of the scientist. When he is observing and recording facts respecting caves he is truly scientific, but when he comes to their explanation he is absurd, and the climax of absurdity is the style of argument that he thinks successfully meets what he chooses to call opposing views and false theories. When he says that geological *leaders* have not visited caverns in sufficient numbers (pp. 56 and 57) one could reply in his fashion by saying that Martel had visited them too much.

Under a section headed "Hypnotisme du cycle d'évolution morphologique" he has a discussion principally of caves, with occasional denials and condemnations of phrases and theories respecting the origin of land forms, but later (p. 299) he accepts the conclusion of Cvijić, characterizing it as "une conclusion synthétique"; but Cvijić has developed the cycle idea, and in this number of the *Geographical Review* that idea is set forth in detail. Cvijić himself develops his idea as one *befitting karsted country*, and no one has ever said that there was no need to have developed the idea of the karst cycle! Just as the normal cycle is modified for glaciated regions or for desert regions, so it must be modified in the case of limestone regions, but this does not mean that the idea of the normal cycle must be abandoned. If we were to accept this line of argument Darwin's work becomes foolish, because it has been modified since the "Origin of Species" was published: and Agassiz was but a blundering amateur when he asserted on looking over the New England landscape that what he saw led him to think that if he had encountered those phenomena at any place in Switzerland he would say the ice had been there!

To Martel we owe a great debt for an intimate knowledge of many caves. To Penck and others we owe something for their development of the idea of the karst cycle. To Cvijić we owe most for the clear amplification of the idea of the cycle and its more rigid application to *the actual conditions of the field*, and particularly for his clear distinctions regarding the *three hydrographic zones in karsted countries*. But outside of these studies of karsted regions

there are great desert areas, and there are also great areas where limestone rock does not occur. And most of these, whether fissured or not, have experienced a quite different development of land forms than those that have been so constantly visited by Martel and have so impressed themselves upon his mind.

One has only unqualified admiration for Martel's courage in making underground explorations that few have dared to make. He has gathered original material from really dangerous sources. In his devoted quest for facts he has never allowed himself to be defeated by conditions, however perilous.

The Physiography of Shore Lines

D. W. Johnson. **Shore Processes and Shoreline Development.** xvii and 584 pp.; maps, diagrs., ills., bibliogr., indexes. John Wiley & Sons, Inc., New York, 1919. $5.00. 9 x 6 inches.

Major Johnson's book is a most noteworthy contribution to the science of physiography, presenting for the first time a full systematic discussion of shore-line development, a subject to which Gilbert, Davis, Gulliver, Jefferson, Abbe, and some others in our own country have made valuable contributions.

The opening chapter of the book treats of water waves, and presents to the reader a brief survey of the literature on the subject, "which may be useful in showing the growth of our knowledge of waves since the time of Leonardo da Vinci." Waves of oscillation, waves of translation, earthquake and explosive waves, and tidal waves all find adequate treatment; such features as wave motion, wave form, wave height, wave length, and wave velocity being carefully worked out. Some notion of the painstaking care bestowed upon the work may be gained when it is noted that the sources on which the author has drawn include nearly two hundred titles given under 168 numbered references at the close of the first chapter. The chapter on the work of waves discusses wave energy, the nature of wave attack, measurements of wave energy, the damage done by storm waves, conditions affecting wave energy, wave refraction, and depth of wave action. The chapters begin with an advance summary and close with a *résumé* followed by a full bibliography. The plan is admirable, and the author's following of it is thoroughly satisfactory.

The transportation of shore débris by many different kinds of currents receives adequate treatment in the author's consideration of the many different types of currents, as wave currents, tidal currents, wind currents, planetary currents, pressure currents, convection currents, salinity currents, and river currents, including also reaction currents, eddy currents, and hydraulic currents (the "polarization currents" of Cornish). This chapter must prove of especial interest to the geologist and the engineer. The harbor engineer is all too prone to believe that the forces operating on the shore line are among the forces of nature that "are subject to no calculation." Work of this kind, however, should make him hopeful that some coming generation may predict shore changes and plan harbor and coast defenses with an assurance wholly unknown today. The references at the close of this chapter present an interesting bibliography, indicating a wide interest in and extensive literature on this subject.

One chapter is devoted to the terminology and classification of shore lines, on which subject Gulliver, J. W. Gregory, Davis, Suess, von Richthofen, Penck, and others have published important papers. Professor Johnson distinguishes shore lines due to submergence from those due to emergence, and he finds that there are neutral shore lines and compound shore lines, where many students of the subject had regarded the shore line as subsiding or even undergoing elevation. This is especially true of his studies of our South Atlantic coast. The author uses the term "tombolo," adapted from the Italian and earlier used by Gulliver, for a connecting bar which ties an island to the mainland. As this word is not yet in common use, the writer of this review should like to see Ovid's word for just such a land-tied island in the Mediterranean or the French-Indian word that is used in the Wisconsin-Michigan district introduced into our literature.

The development of the shore profile is next considered, and the validity of the theory of a marine cycle is discussed. The author here points out that we may have marine peneplains, eolian peneplains, and peneplains due to glacial action, as well as those which are the result of rain and running water. The term "monadnock," which has been defined as "an erosion remnant left standing above a peneplain made by running water," may then be subdivided, and there may be monadnocks due to the incomplete reduction or the incomplete develop-

ment of a marine plain or of a wind-swept plain. The writer of this review is familiar with such an eolian peneplain extending from Kittyhawk Bay to the Kill Devil Hills on the North Carolina Coast.

The three chapters following, on the development of shore lines considered as shore lines (1) of submergence, (2) of emergence, and (3) neutral and compound shore lines, carry the burden of the author's plan and leave nothing to be desired in the wealth of material they present or in clearness of treatment. The author's familiarity with the literature of his subject and his detailed first-hand knowledge of shore lines on both sides of the Atlantic have enabled him to present here a solid and enduring piece of work.

The first of these chapters traces the systematic development of the shore line of submergence from its initial stage of extreme irregularity and complexity until it acquires the regular and simple outline characteristic of full maturity. Special consideration is given to those elements of shore form associated normally with the stages of youth and maturity, such as beaches, spits, bar bays, looped and flying bars, tombolos, cuspate bars and forelands, marsh bars, and bay deltas. The various forms discussed are illustrated by ideal diagrams and by maps of examples taken from nature. Features characteristic of the youth, maturity and old age of shore lines of emergence are then described, and special emphasis is placed on those forms which for any reason merit extended consideration. The origin of the offshore bar is fully discussed, and new evidence is presented to test conflicting theories. The history of tidal inlets is traced in some detail; and, in view of their behavior, modifications of the current explanations of offshore bar development are suggested. In a discussion of all these features, the author has held constantly in view those changes that will prove of value to the harbor engineer as well as to the geologist.

Very naturally the consideration of compound and neutral shore lines develops into a discussion of deltas. Beach ridges are also considered.

The last chapter deals with minor shore forms, such as beach cusps, ripple marks, rill marks, swash marks, shore dunes, and artificial beach cusps—all of which should interest the geologist and the engineer as well as the physiographer.

Collier Cobb

Climatology and Oceanography of Southwest Africa

Alfred Franz. **Beiträge zur Ozeanographie und Klimatologie der Deutsch-Südwestafrikanischen Küste nach Beobachtungen von S. M. S. "Möwe."** 41 pp.; maps, ills. *Aus dem Archiv der Deutschen Seewarte*, Vol. 38, 1920, No. 1. Hamburg.

The *Möwe* was used in 1911–1912 to make a survey of the 750-mile coast and narrow continental shelf of German Southwest Africa. The task was no easy one. The ship was tossed about on the large waves that impinge on this practically harborless coast. Surveying parties could hardly be landed through the heavy surf, even with the assistance of expert Togo negroes; and once ashore on the practically rainless desert there was no food or water to be had, and the low cloud or fog every night prevented sighting on stars. These conditions are typical of the desert coasts of Peru and northern Chile and to some extent also of those of Lower California, West Africa (about 12°–30° N.), and tropical Western Australia —all west coastal deserts in the trade-wind zone. The coldness of the coastal waters is responsible for the cool, foggy yet practically rainless climates of these regions. Although the diverted trade winds may blow prevailingly on-shore, the water wells up behind the seaward deflected currents and flows offshore. As the bottom current rides up the continental shelf of Southwest Africa, water at about 14° C. reaches the surface where the depth is 200 meters and at 13° C. where the depth is 150 meters. On the shore the temperature is usually above 12° if the slope of the bottom is relatively gradual, but below 12° if the bottom is steep, as off Lüderitz Bay (minima, 11.2° summer, and 9.7° winter). As the distance from the shore to the edge of the continental shelf (taken as 200 meters depth) is 25 to 60 miles, the seaward rise in water temperature is 1.5° to more than 3° in this distance (cf. R. E. Coker: Ocean Temperatures Off the Coast of Peru, *Geogr. Rev.*, Vol. 5, 1918, pp. 127–135). As would be expected, the cold water area reaches its greatest extent (9°–34° S.) and lowest temperature in August and its least extent and highest temperature in February. In the warmer months the up-welling probably continues, though the intensity of the high sun warms the water appreciably except where the up-welling is most rapid.

The cold coastal water cools and condenses much of the vapor of winds blowing from warmer waters and thus acts much as a mountain range in shutting off moisture from the coast. Uncomfortably low temperatures, much fogginess and cloudiness, especially in the north, prevail in consequence. Rain (drizzle) seldom occurs, for the heating of the air over the land more than offsets the cooling by expansion as the wind rises on the steep coast. Even though the water is coldest in the south (Lüderitz Bay), the air is coldest in the north (Swakopmund). In the south the southerly wind has a shorter transit over the cold water; the wind is more often offshore and therefore hot (heated in part by compression on descending from the interior); and (owing to more land winds) there is less fog and cloud to shut out the sunlight.

CHARLES F. BROOKS

SOILS OF THE SOUTHEASTERN UNITED STATES IN RELATION TO AGRICULTURE

H. H. BENNETT. **The Soils and Agriculture of the Southern States.** xviii and 399 pp.; maps, ills., bibliogr., index. The Macmillan Co., New York, 1921. $3.50. 8 x 5½ inches.

The author (a native of North Carolina and a graduate of the university of that state) has been connected with the U. S. Bureau of Soils since 1903, first as a soil mapper and later as "inspector" of the southern division, and has had exceptional opportunities to study the soils of the area treated, which ranges from Delaware, Kentucky, and Kansas to a little west of the Pecos River in New Mexico and Texas, making a little over a million square miles, or about one-third of the United States.

The treatment is geographical throughout. One of the text figures is a small soil province map of the United States, reduced from the large one in Bulletin 96 of the Bureau of Soils (reviewed in *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, p. 214), and another figure is the same thing for the southeastern states, on a larger scale with slight revisions. Eight provinces are recognized in this area, viz., the coastal plain, the Great Plains, the Piedmont "plateau," the central prairie region (covering approximately the glaciated or northern half of Missouri), the Appalachian mountains and plateaus, the Mississippi bluffs and silt loam uplands, the limestone valleys and uplands, and the stream bottoms and second bottoms. To treat the last (which is mostly in the coastal plain) as a separate province, as has been done by the U. S. Bureau of Soils for several years past, is objectionable from a geographical standpoint on account of the intricacy and discontinuity of such an area, though the wide alluvial area along the Mississippi River may well constitute a separate region within the coastal plain. The advisability of excluding the loess belt on the eastern side of the Mississippi also from the coastal plain is questionable.

The large colored map in the front of the book subdivides the area more minutely into what are essentially natural regions, about forty in number, each characterized by soils which are of similar origin but differ among themselves in color, texture, moisture, etc. This map is very similar to one by the same author in the section of the Atlas of American Agriculture devoted to cotton, published (under the supervision of O. E. Baker) by the U. S. Department of Agriculture in the spring of 1919; except that it covers a somewhat larger area. It is also comparable with one by E. W. Hilgard at the beginning of the fifth volume of the Tenth Census (1884) and with one by E. A. Smith in the Fourth Report of the U. S. Entomological Commission (1885), both of which are soil region maps in colors, covering the "cotton states."

If the map had been larger and the size of the book unlimited, about twice as many regions could have been distinguished; but of course one has to stop somewhere short of mapping the individual soil types (several hundred in number), and Mr. Bennett has used excellent judgment in this respect.

Any one familiar with the territory described can easily suggest modifications of some of the regional boundaries, but that is inevitable as long as no two authorities agree exactly on the classification of animals or plants or geological formations or anything else. The most obvious possibilities of improvement that occur to the reviewer are that the fertile greensand marl belt of northern Delaware and central Maryland should be separated from the more sandy areas nearer the coast; the long-leaf pine country of southern Alabama and Mississippi should be correlated with the "middle coastal plain" of Georgia rather than with the red hills farther inland; and the long-leaf pine area of western Louisiana and eastern Texas should be distinguished from the pineless country farther west. In these

cases the soil differences may be chemical rather than physical; but they are significant, nevertheless, not only to vegetation but to population and agriculture. The two "black waxy belts" in Texas, given the same color on the map, differ notably in geology, topography, vegetation, and in almost every other respect.

The 51-page introduction discusses general principles, crops, live stock, fertilizers, etc. The next 270 pages are devoted to descriptions of the eight provinces, with special reference to all their important soil series (each province, according to Bureau of Soils usage, having a different set of soil series, with geographical names) and the agricultural features of each group of soils. The treatment of the coastal plain, which includes about one-third of the area and one-half of the regions mapped by the author, is a little more detailed, its subdivisions being described separately to the extent of nearly a page each.

Two appendixes deal with soil analyses. One gives statistics of the amount of several crops produced in each southeastern state in 1917 or 1918. Another is a condensed bibliography, arranged in no apparent order, with dates and number of pages lacking in every case. The index covers 29 pages.

Roland M. Harper

Wild Life in Southern Florida

Charles T. Simpson. **In Lower Florida Wilds.** xv and 404 pp.; maps, ills., index. G. P. Putnam's Sons, New York, 1920. $3.50. 8¼ x 5½ in.

Florida, and especially the southern part of the state, on account of its delightful winter climate and the unlikeness of its geographical features to those of the rest of the United States, has attracted millions of visitors from other states in search of pleasure or information or homes, and a considerable proportion of them have recorded their impressions in print. The average book or magazine article about Florida, however, is the work of some one who has spent only a few weeks or months in the state and never wandered far from the beaten paths and in many cases has had his imagination unduly stimulated by the natural wonders encountered. Even William Bartram, whose book of travels through the South (published in 1791) is one of the classics, and whose description of the natural features of Georgia and Alabama is so faithful that his route through those states can be traced with reasonable accuracy, seems to have given his imagination free rein when he came to Florida and described phenomena which it is almost impossible to believe ever existed.

Mr. Simpson's work stands out in refreshing contrast to the mass of irresponsible or sensational gush about Florida. The author was a conchologist in the United States National Museum from 1889 to 1902 and then retired from professional scientific work and built a home a few miles from Miami, where he has resided ever since. In recent years, in spite of his age (past "three score and ten"), he has made many trips with visiting scientists or alone to remote corners of southern Florida and the West Indies, expressly to study the wild life. His book is consequently packed with accurate first-hand information about the plants, animals, Indians, etc., of this most tropical part of the United States; and at the same time it is not a dry scientific treatise but is charmingly written and fully illustrated. A nine-page index helps make the contents accessible.

The area treated has no definite boundaries but is the southern part of the peninsula, say south of latitude 27°, where frost is almost unknown and the flora and fauna are largely West Indian, though including also a considerable proportion of species peculiar to Florida and a few of wide range. It is difficult to summarize in a few words the variety of topics treated, but the book is a valuable record of numerous aspects of Nature and uncivilized mankind that are rapidly disappearing before the devastating rush of modern civilization. (The population of the southern third of Florida has more than trebled in the last twenty years and doubled in the last ten in spite of the World War. Miami, the chief center of constructive—and destructive—activity, had 5,471 inhabitants in the spring of 1910, 15,592 in the summer of 1915, and 29,549 in January, 1920.) There, as elsewhere in this country, the ideals of the new settlers are mainly mercenary, so that the natural beauties are being destroyed at a fearful rate or in a few cases distorted into parks and private estates. Such a book as this, however, may possibly cause a chosen few to pause and ask if it is really worth while to despoil such a unique wonderland for temporary gain.

Roland M. Harper

Connecticut in Transformation from Colony to State Commonwealth

R. J. Purcell. **Connecticut in Transition, 1775-1818.** x and 471 pp.; maps, bibliogr., index. American Historical Assoc., Washington, D. C., Oxford University Press, London, 1918. 8 x 5½ inches.

This doctoral dissertation in history is set forth as a study of the transition of Connecticut from an aristocratic and theocratic colony to a democratic and modern commonwealth. The introduction outlines an admirable opportunity, within clear-cut bounds of time and space, for accurate and worth-while evaluation of the geographic, economic, social, and political forces which underlie every constitutional change.

Unfortunately the book does not bear out its promise, for it resolves itself into a minute analysis of the political phenomena which accompanied the change from government under charter to government under constitution. The study of social life is confined to religion; the chapters on economic conditions are infirm and lack articulation with the thesis of the book; and geography is dismissed with an implication that since Connecticut possessed no back country, sectionalism could not figure. The reader is repeatedly told that the roots of constitutional evolution lay in religious dissent and in economic development, but nowhere is he shown *how* this soil produced a budding democracy. In this important matter the thesis is not maintained.

Quite aside from the failure of the author to reach his avowed goal, the book is a conspicuous example of certain shortcomings which the monograph seems to breed. Most deplorable of these is the parochial viewpoint with which the subject is treated—scores of persons and dozens of places are mentioned with little or no effort to orient them in the reader's mind. Ninety-nine out of a hundred persons who pick up the book will be completely at sea unless they provide themselves with a dictionary of biography and an atlas of Connecticut.

Dullness in a doctor's dissertation has come to be expected and tolerated, but in the case in question persistent ambiguity of phraseology accentuates this characteristic, with which is closely associated a habit of violating rhetorical principles and an occasional trespass on grammar.

This is not the place to review the value of the work as a treatise in history. The geographer may well ask, however, what such close and assiduous perusal of contemporary records (the bibliography covers thirty-four pages) yields him. This matter may be summarized under five heads: (1) the distribution of dissenting sects, (2) the extent of agriculture as a dominant occupation, (3) the location of centers of commerce, (4) the distribution of rising manufacturing districts, and (5) the centers and spreading area of political groups opposed to the dominant aristocratic Federalism. In each case the reader must make his own synthesis and interpretation, for only scattered facts are given.

Organized dissent from Congregationalism spread into the state from adjacent centers of "infection"— Episcopalianism from New York and Baptism from Rhode Island. Methodists, Separatist Congregationalists, and minor sects possessed no such advantage, but all grew under the desire to escape the tithes levied by societies of the Establishment, or to realize a goal of social democracy. Middletown became an important center, and the river and seaboard towns generally showed more dissenting than established societies by 1818. The upland counties were least hospitable to new-fangled religion.

The Berkshire upland remained dominantly agricultural, and to a less extent this was true of the upland east of Hartford (Tolland County). These were areas of greatest relative emigration, either to near-by manufacturing centers or to the west. With the introduction of merino sheep, the development of manufacturing, and the improvement of roads farms rose in value, and a new economic liaison was effected between factory villages and surrounding food-and-wool-producing farm districts. Lowland farms and the gentle upland of Windham County profited most by this change.

Seafaring populations existed in all the coast and river towns, and with the Napoleonic Wars their business grew apace, only to be impaired by the Embargo of 1809 and permanently curtailed by the recrudescence of British shipping after 1815. Such towns as could do so turned to manufacturing, and shipping became a secondary interest everywhere.

Manufacture was slow to take root because of lack of capital; but with the decline of shipping, the improvement in sheep rearing, and the expansion of textile manufacturing

from the neighboring state of Rhode Island, both woolen and cotton factories came to be important. A picture of 1818 is cited: "In . . . eastern . . . Connecticut the traveller's eye is charmed with the view of delightful villages, suddenly rising as it were by magic, along the banks of some meandering rivulet; flourishing by the influence and fostered by the protecting arm of manufactures" (p. 128. Statistics are presented on pages 137 and 138). The Republicans supported manufacturing and in return received much of their support from the growing laboring population of the villages and cities.

The origin and expansion of Republicanism is proclaimed but not portrayed. Where there was dissent or manufacturing, there was a Republican stronghold. Political success crowned the efforts of years only when the aristocratic manufacturing and banking dissenters joined forces with the humble and poor but numerous laboring dissenters. The final test, which took the form of a referendum on the Constitution of 1818, showed that Fairfield and New London Counties (on the lowland, and bordering New York and Rhode Island respectively) gave the heaviest majorities for ratification, whereas Litchfield, Hartford, and Tolland Counties, comprising mostly agricultural upland, opposed the new instrument of government. New Haven and Middlesex, agricultural lowland counties containing large urban centers, and Windham, a manufacturing and farming section adjacent to Rhode Island, ratified the change by moderate majorities (table, p. 412).

The three maps, showing distribution of dissenting sects and of votes on two critical occasions, are inadequately labeled and can be seen in their true geographic perspective only in comparison with a relief map of the state.

D. S. Whittlesey

A Monograph on Limousin

Alfred Leroux. **Géographie statistique et historique du Pays limousin depuis les origines jusqu'à nos jours.** 207 pp.; maps. Imprimerie et Librairie Limousines, Ducourtieux & Gout, Limoges, 1919. 10 x 6½ inches.

The Limousin was the name of an old province of France lying about halfway between the Garonne and the Loire on the northwestern edge of that great plateau of ancient and, for the most part, crystalline rocks that farther east constitute the Massif Central. The book before us (a revised and much enlarged version of an earlier work by the same author) opens with a very brief account of the physical geography of this region; for more detailed information in this regard the reader is referred to A. Demangeon's excellent article on the relief of the Limousin (*Ann. de Géogr.*, Vol. 19, 1910, pp. 120–149; reviewed in *Bull. Amer. Geogr. Soc.*, Vol. 42, 1910, pp. 840–842) and to a study by Paul Castelnau on the relief of the soil of the Haut-Limousin (*Ann. de Géogr.*, Vol. 23, 1914, pp. 80–83). Leroux's main purpose is to set forth the history of the geographical *circonscriptions* or subdivisions of various kinds into which the Limousin has been apportioned from the times when it formed the home of a Celtic tribe, the Lemovices, or, a little later, when it was the *pagus Lemovicinus major* of the Romans, down to the present day when it constitutes the three *départements* of Haute-Vienne, Corrèze, and Creuse. An immensely complicated history this, though it is quite typical of the history of any one of the former French provinces. Two or three striking facts stand out in the confusing story of the evolution of the Celtic, Roman, ecclesiastical, feudal, royal, and republican territorial units: *pagi*, dioceses, parishes, seigneuries, *baillages*, *généralités*, *élections*, and finally *départements* and *arrondissements*.

Of all of these circumscriptions only one has persisted through the ages with no essential change: the diocese of Limoges is the present-day representative of the *pagus Lemovicinus* of the Romans, of the diocese of the early Gallic church, and of the province of Limousin under the *ancien régime*. It is also constantly borne in on us that "from whatever origin they may be . . . our divisions into circumscriptions are (except in a few cases) without any close correlation with the configuration of the soil" (p. 199) and that "we must note as a fact worthy of comment that the linguistic, juridicial, and economic frontiers . . . never coincide either with the geographic frontier of the *Pays limousin* nor with any chain of hills nor any course of water" (p. 163). This book will give but little satisfaction to the geographer looking for evidences of geographic controls and environmental influences over the complexities of political and administrative territorial divisions.

Leroux's book also gives us some valuable data regarding other matters: lines of communication, distribution of population, cities, educational and charitable institutions.

The boundaries between the *langue d'oc* and the *langue d'oeil* and between the *pays du droit écrit* and the *pays du droit coutumier*—two lines of much significance in the social and legal history of France—both pass through the Limousin and are discussed in some detail. The book is furnished with several amateurish sketch maps unprovided with scales and of a quality for which even the exigencies of post-war-time publication hardly provide an adequate excuse.

On the Historical Geography of Asia

Henri Cordier. **Mélanges d'histoire et de géographie orientales.** Vol. 1, 317 pp.; Vol. 2, 322 pp. Jean Maissonneuve & Fils, Paris, 1914 and 1920. 10 x 6½ inches.

Thanks to profound scholarship, immense versatility, and an easy style both in French and in English, Henri Cordier holds a foremost place among the Orientalists of modern times. Among his more notable publications are the "Bibliotheca Sinica" (Paris, 1904–1908), an enormous bibliography in four volumes of works of all kinds on the Chinese Empire, the "Histoire des relations de la Chine avec les puissances occidentales," 1860–1902 (3 vols., Paris, 1901–1902), and the monumental "Histoire générale de la Chine et de ses relations avec les pays étrangers depuis les temps anciens jusqu'à la chute de la dynastie mandchoue" (4 vols.), which has appeared during the last year (Paris, 1920–1921). English-speaking readers, however, know M. Cordier best as the editor of the third edition of Sir Henry Yule's famous "Travels of Marco Polo" (London, 1903).

The present volumes comprise about thirty monographs, lectures, addresses, and book reviews published in French periodicals during the last forty years. Diverse as is their nature and long as was the period over which they date, all of these miscellaneous publications deal in a general way with the same theme, the study of the relations of the peoples of the West with those of the Far East, a study to which M. Cordier has devoted the greater part of his life. In some the immediate problem attacked is small, and the reader to whom the article or review is addressed is supposedly a specialist; in others the subject is broad and comprehensive, and M. Cordier addresses the general reader.

Among the former specialized items several are of interest to the historian of geography; for example a monograph on the route of Marco Polo across Persia written in the light of the recent discoveries of Sven Hedin and others; a bibliography of the Travels of Sir John Mandeville; notes and documents on the beginnings of the Royal Swedish Company in China; and a paper on the expulsion of the Abbés Huc and Gabet from Tibet in 1846 which establishes without peradventure the authenticity of the travels of these two well-known ecclesiastics, upon which doubts had been expressed by the Russian Prjevalski.

In the more general articles, M. Cordier has brought together invaluable material that in most cases it would be impossible to find so admirably summarized elsewhere. Much of this is of significance in regard to the historical geography of Asia, and its publication in easily available form makes these *Mélanges* a uniquely welcome addition to Orientalist literature. In a lecture delivered in 1881 on the occasion of his opening the course on the "history, geography, and legislation of the Far East" which he has given ever since at the École des Langues Orientales, M. Cordier foreshadowed a future *magnum opus* by giving a brief sketch of the history of the relations of the Occident with the Far East from the earliest times. Along much the same lines were subsequent expositions of relations between Europe and Asia just before and just after the time of Vasco da Gama, of British expansion into Burma in modern days, with notes on the progress of exploration in Farther India, and a review of the history of conflicting British, Russian, and Chinese interests in Tibet, which includes a lucid summary of the course of exploration in that vast highland so critically placed between three Empires.

Several articles, biographical and otherwise, treat of the development of Oriental scholarship, research, and exploration. In the discourse of 1881, which we have already mentioned, Cordier pays a warm tribute to his predecessor at the Écoles des Langues Orientales, Pauthier, the famous French sinologue of the mid-nineteenth century and editor of the edition of Marco Polo's travels best known to the world until it was superseded by that of Sir Henry Yule. There are also obituary sketches of Sir Henry himself, a great scholar with whose name that of Cordier is inseparably associated, and of General de Beylié, famous as the investigator and photographer of the Cambodian ruins of Angkor Wat.

Four monographs, however, deserve special mention above all others. The first of these, an extract from the *Révue Historique* of 1882, bears the title "Travaux historiques sur la

Chine" and is a clear account of the progress of investigation in Chinese history and geography in Western countries down to the date of publication. It should serve as an indispensable introduction to the student of the history or historical geography of the greatest nation of the Orient. The second is a work of much the same sort: a lecture on Central and Eastern Asia delivered before the Sorbonne in 1908, in which M. Cordier again summarized the history of the progress of Chinese studies in Europe and more particularly of those recent geographical and archeological explorations in Central Asia which have yielded of late such immense artistic, archeological and literary treasures. Finally the story of the archeological exploration of Central Asia is carried down to the outbreak of the war by two articles on excavations in Central Asia.

Impressions of India at the Foundation of the East India Company

William Foster, edit. **Early Travels in India, 1583-1619.** xiv and 351 pp.; maps, ills., bibliogr., index. Humphrey Milford, Oxford University Press, London, etc., 1921. 12s. 6d. 7½ x 5 inches.

This well-written and well-edited book consists of the narratives of the journeys of seven Englishmen in India during the years immediately before and after the establishment of the East India Company (1600), and—except for that of the fantastic Coryat who traveled with no other object, it would seem, than to make a name for himself and to "see the Great Mogul in all his glory and ride upon an elephant"—their journeys were all carried out in the interests of British trade. Though the narratives were published by Hakluyt and Purchas, Foster has made them more accessible and intelligible by the addition of introductions, notes, and extensive material not included in the Hakluyt and Purchas versions. The book as a whole gives a vivid picture of India in the days of Akbar and of Nur-ud-din Jahangir and incidentally throws much light on the bitter commercial and political rivalries between Portuguese and British for the trade of the Mogul Empire and other Indian principalities. The most important narrative from the geographical point of view is that of William Finch (1608–1611), a keen and accurate observer, who kept a careful journal and whose observations form a "most valuable contribution to our knowledge of the dominions of the Great Mogul in the early years of the seventeenth century."

Early Voyages in the South Seas

Ida Lee (Mrs. C. B. Marriott). **Captain Bligh's Second Voyage to the South Sea.** xix and 290 pp.; maps, ills., index. Longmans, Green & Co., London, New York, etc., 1920. $4.25. 9 x 6 inches.

Mrs. Marriott is well known to students of early Australian history and of South Sea voyages as the author of several delightfully written books ("The Coming of the British to Australia," 1906; "Commodore Sir John Hayes, His Voyage and Life," 1912; "The Log-Books of the 'Lady Nelson,'" 1915). In the present volume she tells the story of Captain William Bligh's second voyage (1791–1793) from the hitherto unpublished journals kept by Bligh and by Lieutenant Portlock (who commanded the smaller of the two vessels which made up Bligh's little fleet). A chapter is also inserted on the famous mutiny of the crew of the *Bounty*—Bligh's ship during his first voyage—in the course of which the commander and eighteen others were cast adrift in a small boat among the Tonga Islands, whence they made their way through Torres Strait to Timor, over 3,500 miles distant, after a series of desperate sufferings and adventures.

The purpose of Bligh's voyages was primarily to obtain cargoes of breadfruit in the Pacific islands for transportation to Jamaica where it was thought that the cultivation of this plant could be advantageously introduced; incidentally Bligh was instructed to investigate the islands among which his ships would sail and to carry out a thorough examination of Torres Strait. On the second voyage a study was made of the southeastern coasts of Tasmania, and the breadfruit plants were successfully collected at Tahiti. On the return Bligh followed the course which he had taken when escaping from the mutineers. This led him through the Fiji Islands, the larger or western group of which he had discovered in his adventurous voyage of six years before. (The eastern Fijis had been found by Tasman in 1643.) The topographic details of these islands, so far as he could ascertain them, were recorded for the first time upon a chart which is photographically reproduced in Mrs. Marriott's book; and as a consequence of this discovery the Fiji Islands for a short while

were known as Bligh's Islands. A course was then shaped first for the New Hebrides and then for Torres Strait, the channels and islands of which were charted. Bligh entered the straits by "Bligh's Entrance" and left by "Bligh's Channel," two passages that ever since have retained these names and are known today as the safest routes through the dangerous reefs which obstruct the navigation of this important waterway.

History of the Danube as a Commerical Highway

Max Fluss. **Donaufahrten und Donauhandel im Mittelalter und in neueren Zeiten.** 78 pp. (Aus Österreichs Vergangenheit: Quellenbücher zur österreichischen Geschichte herausgegeben von Dr. Karl Schneider, No. 22.) A. Haase, Prague, etc., 1920.

In this booklet are collected forty-eight German translations and quotations from inscriptions, ordinances, charters, chronicles, and other historical sources dealing with trade and navigation on the Danube from the early Roman Empire to the year 1896. The Introduction is a brief and readable summary. During the Roman imperial epoch the Danube served as an artery of commerce, but at the time of the Great Migrations merchant shipping upon it was perforce sadly diminished. A revival came in the Carolingian period; and the Crusades, with the immense incentive to Levantine trade which they brought in their train, placed the river in the forefront among the commercial routes of the world. After the fourteenth century, however, many causes led to the decline in the relative importance of the Danubian route, the most serious of which was the opening of the oceanic waterways to the East. The chief events in nineteenth-century Danubian history were the establishment of the Danube Steamship Company in 1829, of the International Danubian Commission in 1856, and a series of large-scale engineering projects aimed at the improvement of the navigation of the stream, notably the building of the canal at the Iron Gate. There are many data in this booklet illustrating the serious hindrances to free trade that until as late as the nineteenth century were created by toll and customs barriers and by other irksome and restrictive rights of sale or confiscation possessed by the towns along the stream.

Dr. Fluss believes that the economic regeneration of Austria "can only be achieved through the construction of a well developed system of canals available for large ships connecting the Danube with the other rivers of Europe." He gives several selections throwing light on canal schemes of former times, the most interesting of these being an unsuccessful attempt made by Charlemagne to connect the Danube with the Rhine.

The Map of Africa in the Age of the Great Discoveries

Renato Biasutti. **La carta dell'Africa di G. Gastaldi (1545-1564) e lo sviluppo della cartografia africana nei sec. XVI e XVII.** Maps. *Boll. Reale Soc. Geogr. Italiana,* Vol. 9, 1920, pp. 327–346 and 387–436. Rome.

The cartography of those years in which the countries of Europe were prosecuting most vigorously the work of geographical discovery and exploration in distant parts—years covering the sixteenth and seventeenth centuries—appears to be having increasing interest for the student of geography and history at the present time. Not a few monographs, in which the results of a careful and critical study touching the general work of individual cartographers of the period, or of selected examples of their best work, have recently been published. Though inaccuracies, as we know, fill the engraved sheets of the early cartographers, it is coming to be recognized that their work was marvelously well done; and we cannot claim today to have greatly improved on their methods, certainly not in the effort made to be true to the most reliable sources of the time, and to utilize them in a striking and useful manner.

Professor Biasutti's monograph on Gastaldi's map of Africa, dated 1564, is an excellent example of a present-day study touching a most important early cartographical monument. As the theme of the monograph is the map itself, we find but incidental reference to the biography of this famous Italian, one of the most prominent and productive geographers of the sixteenth century, a native of Piedmont, and for many years most active in Venice, that great center of map engraving and printing.

This Gastaldi map of Africa, 1.423 by 1.06 meters in size, is composed of eight engraved sheets. Though now rare in the original, as is noted, it is fairly well known, through such reproductions as that of Nordenskiöld, to students of early cartography.

Professor Biasutti treats first, in brief, its general characteristics, following this with a consideration of its special features as compared with the work of certain earlier cartographers such as that of Ptolemy, Ruysch, Ribero, Santa Cruz, and Agnese, and with a more or less detailed study of its regional records, including its coasts and its islands. He gives critical consideration to much of its geographical nomenclature, not omitting here and there a brief comparison with the records of others. Particular attention has been given to the interior regions, especially to those in which the Nile, the Niger, the Zambesi, and the Congo have their source and through which they flow. Here, it is observed, Gastaldi seems to have been particularly well informed. The author of the monograph makes mention of certain descriptive sources—the records of early travelers and writers—which Gastaldi had before him in the preparation of his map.

In a paragraph, but one of sufficient length, there is reference to African cartography as it appears in other Gastaldi maps; and there is a paragraph on the relation of his work to that of Ramusio and especially to that of Furlani. Not the least significant par. of the monograph points out Gastaldi's relations to Mercator, especially to the latter's work as it appears in his globe map of 1541 and his world map of 1569. To Gastaldi's Africa are traceable practically all important features of that continent, as they appear in the maps of the following century and a half.

E. L. Stevenson

History of Polar Exploration

C. R. Markham. **The Lands of Silence: A History of Arctic and Antarctic Exploration.** xxi and 539 pp.; maps, ills., bibliogr., index. The University Press, Cambridge, 1921. $18.00. 10 x 7 inches.

Sir Clements R. Markham died in 1916 at the age of eighty-six. During well over half a century he was closely associated with polar explorations: when only twenty he took part in the search for Sir John Franklin and when seventy-one he was largely instrumental in bringing about the Royal and Royal Geographical Societies' Antarctic expedition. Nobody had a wider personal acquaintance with the polar explorers of the last seventy-five years, and nobody was more thoroughly steeped in the records of polar adventure in earlier times. Master of a bold and rugged style, blessed with good health, a keen memory, and a mental youth that lasted into extreme old age, Sir Clements was admirably qualified to tell the story of polar discovery. The world is therefore fortunate that he was persuaded to undertake this work, that it was all but completed before his death, and that it has found such an able editor in Mr. F. H. H. Guillemard.

"The Lands of Silence" has something of the quality of an epic. We can hear through its pages the voice of a man, old in years and experience, unfolding a magnificent tale of adventure not merely to amuse and entertain his hearers but as an exhortation and as an example. Sir Clements' picture of the polar world, drawn with poetic realism, is a picture of the polar world as an adversary to *human* enterprise, and it was in the men who took part in the conflict with this adversary that the author was primarily interested. Many pages are devoted to broad, if not subtle, sketches of character and to detailed biographical notes of leaders and lesser officers alike. Sir Clements describes men as types rather than as persons; he appraises them for what they did rather than for what they were; and he glorifies the men of his own nation above all others. The strongest chapters—the ones that leave a lasting impression on the reader's memory—are those concerned with the voyages of English seamen in the days of Elizabeth, with the loss of Franklin, with the British expeditions in search of him, and finally with the magnificent work and tragic death of Scott. The book is written in praise of British seamen and the British navy. Although space is devoted to the explorations of other peoples, it is given a little grudgingly, as an epic poet would chronicle the exploits of the allies as distinguished from the leaders in a great cause. At the close of Part I, on the Arctic, the author writes: "Although the English occupy the first place in Arctic discovery, yet it was begun and was completed by Scandinavians—by Erik the Red and Fridtjof Nansen," and he brings the book to a close with these words: "We may, therefore, hope that the great work initiated by the Societies with such splendid results will be renewed by successors to Scott and Wilson, and that they will again and again raise the standard of duty and useful, if perilous, achievement. For such men there is a note of encouragement and sympathy deep down in the hearts of all true Britons." In these sentences we see what is at the core of Markham's conception of polar explora-

tion—its value as a discipline. More than once he praises the rigorous training in the virtues of hardihood and endurance to be derived from battles with the ice and from winters in the far north or the far south.

As a prose epic of British naval endeavor, then, "The Lands of Silence" is really a great piece of work; but this very fact means that it must lack important qualities when considered from the points of view of history and of science. Though as Americans we are more than ready to admit that the British hold the foremost place in the annals of polar discovery, we cannot help observing that national bias led the author to devote a vastly disproportionate space to those British exploits with which he was personally familiar and in sympathy. The exploits with which he was not in sympathy are damned with faint praise. There is prejudice, for instance, in the minimizing of Peary's work. The series of Antarctic expeditions sent out from the various nations of Europe between 1898 and 1911 made contributions to science that were highly significant; to them the author devotes about one page apiece, but to the British expedition at the same time he devotes twenty-nine pages!

Sir Clements tells us that on frequent occasions he used to express opposition to the search for the poles on the ground that it tended to divert the course of exploration away from more useful channels of geographical and scientific discovery. In spite of this we are not convinced that his foremost interest was scientific. He occasionally mentions details of geologic or other scientific observations, but scrappily and in isolated patches as they appealed to his fancy. Little or no mention is made of the highly significant and interesting climatological discoveries made in the Antarctic in recent years; and H. R. Mill has shown in an admirable review of "The Lands of Silence" (*Nature*, May 5, 1921, pp. 291–292) that its author in nearly every case slighted the biographies of the scientific staffs of expeditions while at the same time he gave minute details concerning the naval staffs. The history of the scientific exploration of the polar regions remains to be written.

The book is beautifully printed and illustrated, contains a valuable chronological table and bibliography by Mr. Edward Heawood, and also a good index. We think, however, that the purchaser of such a costly volume as this is entitled to somewhat better maps. Much of the text is almost unintelligible without constant reference, not to the outline maps provided, but to a first-class atlas.

Bolivia's Claim to an Outlet on the Pacific

D. S. Bustamente. **Bolivia: Su estructura y sus derechos en el Pacífico.** 377 and vi pp. Arnó Hermanos, La Paz, 1919. 6 bolivianos. 9½ x 6 inches.

The legal and historical aspects of the difficulties left over from the War of the Pacific in which Chile occupied and retained portions of Bolivian and Peruvian territory, have often been treated. The work here referred to deals largely with geographical aspects in an attempt to demonstrate Bolivia's right to an outlet to the sea. The author, a lawyer and an experienced statesman, sees in the natural laws controlling the destinies of peoples the strongest grounds for demanding that his country be not deprived of access to the world's greatest highway. In historic connections, in present trade routes, in possibilities of development, in economic dependence Bolivia is essentially a west coast land. Relative distances to markets, distribution of her population (her western highlands contain three-fourths of the inhabitants of the republic), the location of her regions of greatest wealth, the distribution of her resources most needed by the outside world—all of these things bind Bolivia most intimately to the Pacific coast. The remaking of international trade routes by the Panama Canal has only served to intensify this fact. The country is distinctly a hinterland of the Pacific coast. The author believes she always will remain so, however much the agricultural interior provinces may develop, since rail connection via the Andes will ever be the shortest route to shipping points for North American and European ports.

That Bolivia has always faced to the west and that the coastal regions have ever depended upon the highland interior he claims is evidenced by the facts that many of the place names in the former district are of Quechua origin, that ancient roads were built to facilitate that natural connection, that in colonial times the littoral provinces found their most natural administrative dependence to be upon the plateau rather than upon the coastal capitals, and that even the age of maritime commerce finds its easiest access to Bolivia via the west coast ports.

The author advocates solution of the problem by the cession of a lane connecting La Paz with Arica, her most natural and convenient port.

Educational Geography

J. F. Chamberlain. **Geography: Physical, Economic, Regional.** (Lippincott's School Text Series.) 509 pp.; maps, diagrs., ills., bibliogrs., indexes. J. B. Lippincott Co., Philadelphia, 1921. $3.00. 8½ x 6 inches.

This book, designated for pupils of the secondary schools, is written around the thought that "to perform efficiently and justly our part in world and national affairs, we must know geography." We must know enough physical geography to give a proper foundation to our knowledge, enough economic geography to satisfy the demands for growth and influence in every walk in life, and we must know our own country beyond the bounds of superficiality. Certainly if, making use of this text, the study is carefully and skillfully conducted all these things will be accomplished, for the book has a surprising amount of information in its 500 pages. In general the chapters on physical geography discuss the usual topics of physiography plus a few chapters on relationships; the second portion of the book deals with the industries from the standpoint of their products; and the final pages are devoted to a regional geography of the United States.

Any estimate of the value of the book must take account of the status of geography in elementary and secondary schools. For replacement of physiography by general science in secondary school courses, the textbook, to be sure, cannot be blamed except indirectly; but a textbook to recover the lost ground must be constructed along radically different lines from those of a few years ago. It does not appear that this book is the Moses for which geographers have been scanning the horizon to lead them into the promised land. There is an independence shown by the author in the arrangement, in the correlations, and to some degree in the subject matter; but little in the treatment of the various subtopics. The book would be a direct contribution if other books similar in type had been able to hold the field for geography in the secondary schools; but, measured by the history of the subject in the high schools, the book is disappointing.

Again, some of the distaste for geography in secondary schools is caused by the teacher's inadequate presentation of the subject. The repetition of items without advanced treatment of them is a serious obstacle to the enjoyment and progress of geography in many school systems. The reviewer questions whether the treatment of the regional geography of the United States in this book is on a sufficiently advanced plane, particularly when compared with "Practical Exercises in Geography: Book One," which is used successfully in the sixth grade.

It is admittedly harsh treatment to attempt to compare a book with an ideal that cannot be realized at present. The stages towards this ideal will probably be slow and tedious, but every step in the right direction is a gain; and there is enough in this book to make it a new leader in the field of secondary school geography. Geographers will watch with interest the reception of the book.

Robert M. Brown

Food Production and Requirements of the United States

Raymond Pearl. **The Nation's Food: A Statistical Study of a Physiological and Social Problem.** 274 pp.; map, diagrs., index. W. B. Saunders Co., Philadelphia and London, 1920. $3.50. 9½ x 6½ inches.

Before the World War statistics in the United States were a little like firearms. Save for the census needed as a basis of Congressional representation, and the imports and exports needed for tariff legislation, statistics were too often a kind of private luxury, like shot guns and fishing tackle. The Department of Agriculture published some *estimates* and diligently gathered up and compiled other people's figures, but on the whole we were a very non-statistical nation.

The war put the manufacture of firearms and of statistics on an entirely new basis for a time. Scores of questions like this needed to be answered: "What is our normal consumption of ————?" "How much ———— can we spare for export?" This desire for knowledge covered almost every important commodity. To answer these questions in the light of war

needs, new statistical shops sprang up by the dozen and numbered their employes by the thousand.

Dr. Raymond Pearl was chief of one of these mushroom and unfortunately ephemeral statistical bureaus, that of the U. S. Food Administration, and he is one of the few war statisticians who has succeeded in making a permanent record. This book is his valedictory, and it brings together the results of vast labor.

It is partly a war document, but it is of permanent value. Many of its compilations compare the war period with the prewar period, and any person interested in the statistics of any particular food should consult it for references as to the sources.

The book contains 9 chapters and 77 tables comprising a great variety of information relating to production, consumption, import, and export of food and food elements.

J. Russell Smith

Annals of the Association of American Geographers

Annals of the Association of American Geographers, Vol. 10. 160 pp.; maps, diagrs., ills., index. Assoc. Amer. Geogr. and Amer. Geogr. Soc., New York, 1920. $3.00 unbound; $3.50 bound. 10½ x 7½ inches.

Volume 10 of the Annals deals with the proceedings of the fifteenth annual meeting of the Association at St. Louis (*Geogr. Rev.*, Vol. 9, 1920, pp. 139–140). The papers published in full are: Genetic Geography: The Development of the Geographic Sense and Concept, by C. R. Dryer (Presidential Address), pp. 3–16; The Boundaries of the New England States, by S. W. Cushing, pp. 17–40; The Influence of Lake Michigan upon Its Opposite Shores, with Comments on the Declining Use of the Lake as a Waterway, by R. H. Whitbeck, pp. 41–55; Weather Conditions and Thermal Belts in the North Carolina Mountain Region and Their Relation to Fruit Growing, by H. J. Cox, pp. 57–68; Rainfall of the Great Plains in Relation to Cultivation, by J. Warren Smith, pp. 69–74; Features of Glacial Origin in Montana and Idaho, by W. M. Davis, pp. 75–147; Memoir of Frederick Valentine Emerson, by A. P. Brigham, pp. 149–152.

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ERRATA

p. 44, lines 3 and 2 from bottom: *for* Embrum *read* Embrun.
p. 137, lines 5 and 12: *for* MacDougall *read* MacDougal.
p. 142, line 15 from bottom: *for* Cherzo *read* Cherso.
p. 181, line 6: *for* between two and three per square kilometer *read* one to every two or three square kilometers.
p. 280, line 13 from bottom: *for* Margarie *read* Margaree.
p. 282, line: *for* Marjorie *read* Margaree.
p. 440, Table II, column 2 near end, opp. Duluth: *for* 43 *read* 44.
p. 466, line 8: *for* D. L. Whittlesey *read* D. S. Whittlesey.
p. 467, at end of first paragraph supply the signature H. H. Barrows.
p. 525, add to legend of Fig. 20: Numbers under "communications" have the following reference. Roads: 1. Roman track; 2, carriage road built before the war; 3, carriage road built during the war; 4, mule track. Field railways built during the war: 1, upon Roman track; 2, upon old road; 3, upon new road. Bridges: 1, remains of Roman bridge; 2, Turkish stone bridges; 3, wooden bridges built during the war (except that across the Arzen River).

Additional Errata in Vol. X

p. 168, line 8: *for* geographical *read* statute.
p. 424, line 13: *insert before* $200.00: Approximate price for entire series (9 volumes).